Responsiveness Summary

Lower Fox River and Green Bay, Wisconsin Site

Record of Decision, Operable Units 3, 4, and 5

Wisconsin Department of Natural Resources
101 S. Webster Street
Madison, Wisconsin 53703

Wisconsin Department of Natural Resources
Northeast Region
1125 N. Military Avenue
Green Bay, Wisconsin 54307

U.S. Environmental Protection Agency, Region 5
Superfund
77 W. Jackson Boulevard
Chicago, Illinois 60604

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List of White Papers

List of Acronyms

µg/kg	micrograms per kilogram
Agencies	Wisconsin Department of Natural Resources and United States Environmental Protection Agency
API	Appleton Papers, Inc.
API Panel	Appleton Paper, Inc., Panel
ARAR	applicable or relevant and appropriate requirement
ATSDR	Agency for Toxic Substances and Disease Registry
AVM	Acoustical Velocity Meter
Bay	Green Bay
BLRA	Baseline Human Health and Ecological Risk Assessment
BTAG	Biological Technical Assistance Group
CAD	confined aquatic disposal
CDF	confined disposal facility
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cm	centimeter
CSF	cancer slope factor
CTE	central tendency exposure
CWAC	Clean Water Action Council
cy	cubic yard
cy/hr	cubic yards per hour
DMR	Data Management Summary Report
EPA	United States Environmental Protection Agency
FDA	Food and Drug Administration
FIELDS	Fully Integrated Environmental Location Decision Support
FRFood	Fox River Food Model
FRG	Fox River Group
FS	Feasibility Study
GBFood	Green Bay Food Chain Model
GBMBS	Green Bay Mass Balance Study
g/cy	grams per cubic yard
GFT	glass furnace technology
GIS	geographical information system
IDW	Inverse Distance Weighting
kg	kilogram
LaMP	Lake-wide Management Plan
LTI	Limno-Tech, Inc.
LTMP	Long-Term Monitoring Plan
MEE	Microexposure Event
mg/kg	milligrams per kilogram
MNR	Monitored Natural Recovery
NAS	National Academies of Science
NCP	National Contingency Plan
ng/m^3	nanograms per cubic meter
NOAA	National Oceanic and Atmospheric Administration

List of Acronyms

NRC	National Research Council
OU	Operable Unit
OU 1	Little Lake Butte des Morts
OU 2	Appleton to Little Rapids
OU 3	Little Rapids to De Pere
OU 4	De Pere to Green Bay
OU 5	Green Bay
Panel Report	Ecosystem-Based Rehabilitation Plan
PCB	polychlorinated biphenyl
ppb	parts per billion
ppm	parts per million
Proposed Plan	Proposed Remedial Action Plan
RAL	remedial action level
RAO	remedial action objective
RD	remedial design
RfD	reference dose
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
River	Lower Fox River
RME	reasonable maximum exposure
ROD	Record of Decision
RP	Responsible Party
RS	Responsiveness Summary
Site	Lower Fox River and Green Bay Site
SMU	Sediment Management Unit
SQT	sediment quality threshold
SWAC	surface-weighted average concentration
TAG	Technical Assistance Grant
TBC	to be considered
TTA	Time Trends Analysis
USACE	United States Army Corps of Engineers
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WDNR	Wisconsin Department of Natural Resources
wLFRM	whole Lower Fox River Model
Workgroup	Model Evaluation Workgroup
WPDES	Wisconsin Pollution Discharge Elimination System

Executive Summary

This document is the *Responsiveness Summary for the Lower Fox River and Green Bay, Wisconsin Site Record of Decision for Operable Units 3, 4, and 5*. This Responsiveness Summary (RS) is being released subsequent to the *Responsiveness Summary for the Lower Fox River and Green Bay, Wisconsin Site Record of Decision for Operable Unit 1 and Operable Unit 2* (RS for OUs 1 and 2), which was made available to the public in January 2003. In October 2001, the Wisconsin Department of Natural Resources (WDNR) and United States Environmental Protection Agency (EPA) (collectively "the Agencies") released the *Proposed Remedial Action Plan, Lower Fox River and Green Bay* (Proposed Plan). Although the Proposed Plan recommended a cleanup plan for all five Operable Units (OUs 1 through 5) at the Lower Fox River and Green Bay Site (the Site), the Agencies are issuing two separate Records of Decision (RODs): one for OUs 1 and 2 and one for OUs 3, 4, and 5. There is an RS associated with each of the RODs.

As with the RS for OUs 1 and 2, this RS for OUs 3, 4, and 5 concludes a comprehensive comment process during which the Agencies accepted public comment on the Proposed Plan, the *Remedial Investigation for the Lower Fox River and Green Bay, Wisconsin* (RI), and the *Feasibility Study for the Lower Fox River and Green Bay, Wisconsin* (FS). These documents were presented to the public through an extensive public-involvement program, which began even before the initiation of the formal public comment period. The public-involvement program included numerous meetings/forums presented by the Agencies for and with the public.

The WDNR released a draft Remedial Investigation/Feasibility Study (RI/FS) for public review and comment in February 1999. Comments were received from other governmental agencies, the public, environmental groups, and private-sector corporations. The Agencies used these comments to revise and refine the scope of the RI/FS and Proposed Plan, which were released for public comment in October 2001, as announced in a press conference on October 5, 2001. This press conference was followed by extensive coverage through television, radio, and newspaper stories. The Proposed Plan was made available to the public through the formal comment process from October 5, 2001, until January 22, 2002.

Public comments were accepted during the comment period. Additionally, the WDNR and EPA mailed meeting reminders and Proposed Plan summaries to the 10,000 parties identified in the Lower Fox River mailing list who receive the *Fox River Current* newsletter. As with the Proposed Plan, press releases regarding the comment period and the public-support meetings were sent to newspapers and television and radio stations throughout the Fox River Valley. Further, newspaper advertisements announcing the availability of the Proposed Plan and its supporting documents were placed in the *Green Bay*

Press Gazette and the *Appleton Post Crescent*. A copy of the Proposed Plan was placed in the Site's information repositories. In addition, the Proposed Plan, the draft RI/FS, and other supporting documents containing information upon which the proposed alternative was based were made available on the WDNR's website.

In response to this public outreach, the WDNR and EPA received approximately 4,800 written comments via letter, fax, and email. The Agencies have made an exhaustive effort to respond to all of the comments received. Through the comment process, the Agencies reached agreement on remedial action plans for all five OUs, as set out in the two separate RODs. The second of those RODs, to which this RS is attached and into which this RS is incorporated, is being released at this time.

This RS is a companion document to the RS for OUs 1 and 2. Many of the comments addressed in the RS for OUs 1 and 2 are generally applicable to the entire Lower Fox River and Green Bay Site. Therefore, this RS specifically addresses comments received during the comment period that focus on OUs 3, 4, and 5. For continuity and clarity, the organization of the documents is identical (i.e., sections and subsections are presented in the same order, and the numbering of Master Comments follows sequentially from the RS for OUs 1 and 2).

This Executive Summary describes the background of the Site as it was originally presented in the first RS. It further describes the RODs and highlights the topics commented upon and responded to in the RS for OUs 3, 4, and 5. For each topic/Master Comment discussed here, a detailed response can be found within the main body of this RS.

Site Description and Background

The Lower Fox River (River) and Green Bay (Bay) Site includes an approximately 39-mile stretch of the Lower Fox River and all of Green Bay. The River portion of the Site extends from the outlet of Lake Winnebago and continues downstream to the River's mouth at Green Bay, Wisconsin. The Bay portion of the Site includes all of Green Bay, from the city of Green Bay north to Big Bay De Noc, to the point where the Bay enters Lake Michigan.

For many years, paper mills have been — and continue to be — intensely concentrated along the River. Some of these mills operated de-inking facilities in connection with the recycling of paper. Others manufactured carbonless copy paper. Polychlorinated biphenyls (PCBs) were used in the emulsion that coated carbonless copy paper. In the de-inking process and in the manufacturing process, PCBs were released from the mills to the River, either directly or after passing through wastewater treatment works. PCBs have a tendency to adhere to sediment and, consequently, have contaminated

the River sediments. In addition, PCBs and contaminated sediments have been carried downriver and into the Bay.

For ease of management and administration, the Site has been divided into five discrete areas referred to as Operable Units (OUs). The River has been divided into OUs 1 through 4 and Green Bay constitutes OU 5. These OUs are:

- OU 1 – Little Lake Butte des Morts
- OU 2 – Appleton to Little Rapids
- OU 3 – Little Rapids to De Pere
- OU 4 – De Pere to Green Bay
- OU 5 – Green Bay

Record of Decision

The Record of Decision for OUs 3, 4, and 5 presents the selected remedial action for those Operable Units and is an adjunct to the ROD addressing Operable Units 1 and 2, which was released in January 2003. Together, the two RODs represent the completion of a remedial decision-making process and present the final remedial decisions for the entire Site.

The RI/FS and subsequent investigation showed that the PCBs reside primarily in the sediments in the River and Bay. Therefore, the remedial plan focuses on action involving the PCB-contaminated sediments. Removal of PCB-contaminated sediments will result in reduced PCB concentrations in fish tissue, thereby accelerating the reduction in potential future human health and ecological risks. The Agencies believe that the human health and ecological risks created by PCBs will be addressed by the remedial actions selected and documented in the ROD for OUs 3, 4, and 5.

Presently, OU 3 contains approximately 1,250 kilograms (kg) (2,750 pounds) of PCBs in 3,030,100 cubic yards (cy) of sediment. The ROD for OUs 3, 4, and 5 provides for the removal of 1,111 kg (2,444 pounds) of PCBs from OU 3 through the dredging of 586,800 cy of contaminated sediments. In addition, the ROD calls for the removal of sediments in Deposit DD in OU 2 as part of the OU 3 remedy. Deposit DD adds approximately 9,000 cy of contaminated sediment and 31 kg (68 pounds) of PCB mass to the OU 3 project.

OU 4 is estimated to contain approximately 26,650 kg (58,620 pounds) of PCBs in 8,491,400 cy of sediment. The ROD for OUs 3, 4, and 5 provides for the removal of 26,433 kg (58,150 pounds) of PCBs from OU 4 through the dredging of 5,879,500 cy of contaminated sediments.

For OU 5, the selected remedy is Monitored Natural Recovery (MNR). MNR is the monitoring of natural processes, such as degradation, dispersion, and the burial of contaminant concentrations, to the point at which the contaminants are no longer of concern. The MNR alternative includes a 40-year monitoring program for measuring PCB levels in water, sediment, fish, and birds to effectively measure progress toward and achievement of the remedial action objectives for OU 5. The selection of the MNR for OU 5 is discussed in more detail in a separate subsection below.

The Agencies have estimated that the cost for the remedial action is $284 million for OUs 3 and 4 and $39.6 million for OU 5. Although these cost estimates represent an increase from the estimate set forth in the Proposed Plan, the Agencies believe the cost estimates to be reasonable. A full evaluation of costs for implementation of the remedy in OUs 3 and 4 is contained in *White Paper No. 23 – Evaluation of Cost and Implementability of Alternative C2B for Operable Unit 3 and Operable Unit 4*.

Issuing two separate RODs made a phased approach to the remedial work possible, allowing work on upstream areas to commence first, consistent with the Agencies' policy. In addition, addressing upstream contamination first will dramatically reduce the downstream transport of PCBs and will not interfere with further downstream remediation. Reasons for issuing two separate RODs also include the following:

- OUs 1 and 2 represent approximately 6.5 percent of the PCB mass and 18 percent of the sediment volume in the River. Because they account for a smaller portion of the River area requiring remediation than do OUs 3, 4, and 5, OUs 1 and 2 present a project of more manageable size.

- Therefore, planning for the remedial action at OUs 3, 4, and 5 may benefit from knowledge gained during remedial activities conducted on a smaller scale for OUs 1 and 2.

Comments and Responses

Remedial Investigation

Definition of Operable Unit 4

Many comments were received regarding the possible division of OU 4 into two operable units (4A and 4B). Following careful review of these comments, the Agencies found no compelling reason to change the current definition of OU 4. The Agencies' basis for defining OU 4 as a single River reach include the following:

- That a large and continuous layer of soft sediment is present from the De Pere dam to the River mouth
- That there are no dams downstream of the De Pere dam
- That this reach has been modeled in the past as a single model unit
- That fish move throughout the entire reach and, from a risk-management perspective, are exposed to PCBs over the entire OU

In addition, an independent panel of professors and scientists (the Appleton Paper, Inc., Panel, referred to as "the API Panel") evaluated the Proposed Plan and completed a report entitled *Ecosystem-Based Rehabilitation Plan – An Integrated Plan for Habitat Enhancement and Expedited Exposure Reduction in the Lower Fox River and Green Bay*. This report, dated January 17, 2002, pointed out many similarities between the two parts of OU 4, including that they have similar flow velocities, that the entire OU is subject to seiche effects, and that the substrate is predominately soft sediment. In addition, the WDNR's Model Evaluation Workgroup demonstrated in *Technical Memorandum 2g: Quantification of Lower Fox River Sediment Bed Elevation Dynamics through Direct Observations* (July 23, 1999) that the riverbed in OU 4 is dynamic throughout the OU.

For all of these reasons, the Agencies determined that dividing OU 4 into two separate zones would be inappropriate.

Green Bay Mass and Volume Estimates

Several commenters expressed concern about mass and volume estimates for total PCBs in Green Bay. The estimates of PCB mass in the Lower Fox River and Green Bay in the RI/FS were generated from Technical Memoranda 2e and 2f, respectively, which are included in the *Final Model Documentation Report for the Lower Fox River and Green Bay, Wisconsin* (Model Documentation Report). The Agencies conferred with University of Wisconsin researchers who had previously performed a mass estimate for Green Bay, and the WDNR conducted a side-by-side evaluation of the two methods used for estimating PCB mass and volume. The procedures and results of this work are discussed in *White Paper No. 18 – Evaluation of an Alternative Approach of Calculating Mass, Sediment Volume, and Surface Concentrations in Operable Unit 5, Green Bay*. The general findings of White Paper No. 18 are that the mathematical approaches used in Technical Memorandum 2f and by the University of Wisconsin are both valid, with similarities in the way mass and volume are estimated. *An important finding is that regardless of the method used, PCB surface concentrations estimated for the Green Bay zones are similar*. The Agencies have concluded from these results that the differences in PCB mass estimates are not the result of

the process or the mathematical models used, but arise from decisions about which data to include in the interpolation. The Agencies further determined that the PCB mass estimates derived in White Paper No. 18 following the University of Wisconsin methodology likely represent a sound estimate of PCB mass in Green Bay using a well-defined data set.

In July 2002, the WDNR and EPA collected additional data from Green Bay that has been incorporated into new PCB distribution maps included in *White Paper No. 19 – Estimates of PCB Mass, Sediment Volume, and Surface Sediment Concentrations in Operable Unit 5, Green Bay Using an Alternative Approach*. The estimates of PCB mass and volume presented in White Paper No. 19 are based on the alternative methods outlined in White Paper No. 18. Those estimates are 14,565 kg (32,116 pounds) of PCB mass and approximately 266,000,000 cubic meters (350,000,000 cy) of contaminated sediments in Green Bay. The results of the work conducted for White Paper No. 18 and White Paper No. 19 have been discussed with University of Wisconsin researchers.

Given the potential uncertainty associated with PCB mass estimates and the perceived presence of elevated levels of PCBs in Green Bay, the WDNR took the step of conducting two additional modeling evaluations. These model evaluations are documented in *White Paper No. 20 – Green Bay Modeling Evaluation of the Effects of Sediment PCB Bed Map Revisions on GBTOXe Model Results* and *White Paper No. 21 – Green Bay Modeling Evaluation of a Hypothetical Open-Water Disposal Site for Navigational Dredged Material in Southern Green Bay*. The additional modeling presented in White Paper No. 20 demonstrates that changes to PCB mass in Zone 2 of OU 5 do affect the initial conditions for the GBTOXe model, but the effect is to make those initial conditions more consistent with zones 3A, 3B, and 4 of OU 5.

The second model white paper (White Paper No. 21) evaluated how sediments dredged from the federally maintained navigation channel and disposed of in the open-water disposal areas that were operated up until the 1970s might have affected PCB distribution in the Bay. That work illustrated how PCBs within a hypothetical dredge material disposal site would be initially high in Zone 2 but would tend to become less appreciable within a 10-year time frame. Furthermore, there is no appreciable impact to sediment and water column PCB concentrations for zones 3A, 3B, and 4. In addition to the modeling work, additional samples collected within those areas did not show any detectable PCBs. Collectively, these results demonstrate that concerns about elevated PCBs from dredged material disposal are unfounded.

The end result of this work on the Bay is twofold. First, the Agencies believe the work is adequate for decision-making purposes and, therefore, the Agencies are proceeding with selection of the remedy for OU 5, which is MNR. The MNR alternative relies on naturally occurring degradation,

dispersion, and burial processes to reduce the toxicity, mobility, and volume of contaminants. In selecting MNR for the Bay, the Agencies considered Superfund guidance on the nine evaluation criteria for determining whether remediation is necessary or not.

Second, the Agencies plan to conduct further remedial evaluations for Green Bay, including conducting the GBTOXe and GBFood models using the lower mass and volume estimates from White Paper No. 19. Once these evaluations are complete, the Agencies will make the results public. If the Agencies find there is reason to reconsider the MNR alternative for Green Bay, they will do so; steps in that process would include issuing a Proposed Plan, holding a public comment period, considering the comments, and finalizing a ROD Amendment.

Technical Remedial Alternatives

Vitrification

Several commenters recommended vitrification as a remedial alternative to the landfill placement of sediments. The Agencies have continued to work on evaluating the cost- and treatment-effectiveness of vitrification as a potential remedial alternative that could be identified in the remedial design phase. The WDNR recently completed a pilot-scale evaluation of vitrification, or glass furnace technology (GFT). The outcome of that study reflects that vitrification could be selected as the process option in this remedial alternative or for portions of other alternatives for OUs 3 and 4.

Dredge Slurry Pipeline

Some commenters questioned the implementability of a pipeline to carry dredge slurry to an upland disposal facility, which would be located a considerable distance from the River. The WDNR and EPA believe that the pipeline alternative is both technically feasible and implementable. A project-specific example of the feasibility of this technology can be found in the White Rock Lake (Texas) sediment dredging project (described in Section 6 of the FS), in which a 20-mile-long pipeline was used to transport 3 million cy of hydraulically dredged sediment in one year. The WDNR expects that similar success could be achieved utilizing pipeline transport technology in the Lower Fox River sediment remediation project. The WDNR and EPA plan to empanel an experienced expert technical review team to further assess planning for and construction and operation of the pipeline and disposal facility. In addition, the WDNR prepared White Paper No. 23, which reviewed technical and cost issues associated with the Proposed Plan for OUs 3 and 4, as well as the possible use and cost of a pipeline to remove dredge slurry from the River. It was determined that Alternative C2B (use of a pipeline to transfer dredge slurry) is an implementable and technically feasible alternative.

Selection of the MNR Remedial Alternative for OU 5

Several commenters disagreed with the selection of MNR as a remedial alternative for OU 5. In general, the basis for their disagreement was that MNR would not sufficiently reduce risks to the public and the environment.

The Agencies cannot agree with the expenditure of significant resources when there may be little or no benefit associated with the work. The Agencies found that none of the remedial action levels (RALs) identified in the FS provides 100 percent protection immediately after remediation (or after initiation of MNR) for all of the human or ecological receptors in the Lower Fox River or Green Bay. As summarized in Table 8-15 of the FS, none of the RALs modeled would achieve human health remedial action objectives (RAOs) in Green Bay earlier than more than 100 years after remediation. The remedial modeling forecasts (Section 8 of the FS) show that even remediating nearly 90,000,000 cy of sediment in OU 5 would achieve only limited reduction of human health and ecological risks. Given the limited risk reduction and the substantial costs and difficulties of implementing an active remedial solution, the WDNR and EPA believe that MNR is the only feasible option for Green Bay. In addition, sediments in Green Bay near the mouth of the Lower Fox River that contain PCB concentrations above 1 part per million (ppm) will be remediated as part of the removal at OU 4. This will enhance the benefits of reduced loading from the Lower Fox River as well as remove the area in Green Bay having the greatest PCB concentrations.

The proposed remediation of the Lower Fox River is expected to reduce future PCB loadings by 98 percent, and the Agencies believe that addressing continuing PCB discharges to Green Bay will be more cost-effective at reducing long-term risks in Green Bay than would active remediation in any portion of the Bay. The Agencies will continue to evaluate remedial alternatives for the Bay through the use of the GBTOXe and GBFood models and to make the results of these evaluations public.

The remedial decision-making process for OUs 3, 4, and 5 is fully described in *White Paper No. 22 – Remedial Decision-Making for the Lower Fox River/Green Bay Remedial Investigation, Feasibility Study, Proposed Remedial Action Plan, and Record of Decision for Operable Units 3 through 5*.

Implementability of Remedy—Disposal of Dredged Sediments

Some commenters expressed concern about the feasibility of disposing of the dredged, PCB-contaminated sediments. Commenters specifically noted the problems of siting and constructing a landfill in southern Brown County and the prohibitive cost of shipping dewatered sediment out of state. After investigating the issue, the Agencies concluded that the construction of such a disposal facility is feasible. Similar, larger landfills do currently exist in

Wisconsin. The Agencies believe that while siting a landfill may be difficult, it is feasible with the cooperation of the local parties and county, state, and federal officials. To facilitate this option, the WDNR has supported legislation to indemnify municipal landfills and publicly owned treatment works that accept sediment and leachate from sediment remediation projects (S. 292.70 Wisconsin State Statutes). The Agencies also concluded that tipping and transportation costs would be high if dredged sediments had to be shipped out of state.

Conclusion

The WDNR and EPA, after extensive public involvement and input, have selected a remedy for the Site that will achieve a protective result for human health and the environment by meeting the Site RAOs, as set forth in the Proposed Plan and the ROD for OUs 3, 4, and 5.

The Responsiveness Summary that follows presents comments associated with OUs 3, 4, and 5 that were received during the comment period, along with the Agencies' responses to those comments. This RS was prepared with the same level of effort as, and is a companion document to, the RS for OUs 1 and 2. The comments and responses presented in this RS were used in selecting the final remedy for OUs 3, 4, and 5. This Responsiveness Summary completes the comment process for the entire Site.

The ROD for OUs 3, 4, and 5, the accompanying Responsiveness Summary, and the associated white papers are available at the WDNR's website, the Fox River information repositories, and in the Administrative Record for the Site. The complementary ROD for OUs 1 and 2 and associated documents, including the RS for OUs 1 and 2, are also available at those locations. The WDNR's website address is:
http://www.dnr.state.wi.us/org/water/wm/lowerfox/index.html.

The Administrative Record for the Site can be found at:

Wisconsin Department of Natural Resources
Remediation and Redevelopment – 3rd Floor
101 S. Webster Street
Madison, Wisconsin 53707
Contact: Jill Castleberg
(608) 266-5247

Wisconsin Department of Natural Resources
Lower Fox River Basin
801 E. Walnut Street
Green Bay, Wisconsin 54301
Contact: Kelley O'Connor
(920) 448-5133

Office Hours are Monday through Friday, 8:00 a.m. to 4:30 p.m. Please call for an appointment. These materials are also available at the EPA Region 5 office at:

United States Environmental Protection Agency
Office of Public Affairs
77 W. Jackson Boulevard
Chicago, Illinois 60604-3511

Public information repositories are located at:

Appleton Public Library
225 N. Oneida Street
Appleton, Wisconsin 54911-4717

Brown County Library
515 Pine Street
Green Bay, Wisconsin 542301-5139

Door County Library
107 S. Fourth Avenue
Sturgeon Bay, Wisconsin 54235-2203

Oneida Community Library
201 Elm Street
Oneida, Wisconsin 54155-8934

Oshkosh Public Library
106 Washington Avenue
Oshkosh, Wisconsin 54901-4933

1 Legal, Policy, and Public Participation Issues

Section 1 of the RS for OUs 1 and 2 included the following subsections:

- *1.1 Policy Issues*
- *1.2 CERCLA Requirements and Issues*
- *1.3 Applicability of NAS/NRC and 11 Principles*
- *1.4 ARARS and TBCs*
- *1.5 Public Participation and Concerns*

The RS for OUs 3, 4, and 5 follows the same general organization as the RS for OUs 1 and 2. However, many of the comments addressed in the RS for OUs 1 and 2 were generally applicable to the entire Lower Fox River and Green Bay Site and so are not repeated here. Because there are no new comments associated with Sections 1.1, 1.2, 1.3, and 1.5, those sections are not included in the RS for OUs 3, 4, and 5. Prior comments associated with those sections can be found in the RS for OUs 1 and 2, which is available on the WDNR website, at the various information repositories, and in the Administrative Record for the Site. The WDNR's website address is: http://www.dnr.state.wi.us/org/water/wm/lowerfox/rifs/index.html.

Section 1 of the RS for OUs 1 and 2 included Master Comments 1.1 to 1.24. Master Comment 1.25 is therefore the first comment in the RS for OUs 3, 4, and 5.

1.4 ARARs and TBCs

ARARs stands for "applicable or relevant and appropriate requirements." TBCs stands for "to be considereds." ARARs are promulgated cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations; TBCs are guidelines and other criteria that have not been promulgated.

Master Comment 1.25

Commenters recommended that a River and Bay PCB Remediation Advisory Committee be created as an oversight group without veto power but with the power to force reconsideration and/or appeal upon a majority vote and public interest advocacy.

Response

Through an EPA program called Technical Assistance Grants (TAGs), the Clean Water Action Council (CWAC), which is based in Green Bay, has

received $150,000 to hire its own technical advisor to interpret and provide input on information generated by the WDNR and EPA. The CWAC's technical advisors can also serve as liaisons between the CWAC and the Agencies. In addition, the CWAC is using TAG funds to maintain its website, produce printed materials, and mail informational pieces to those on its mailing list.

While the TAG program does not provide its participants with veto power or the ability to force reconsideration of various aspects of the cleanup, it does encourage groups to serve as local points of contact for their communities. TAG recipients are obligated to inform the rest of the community about what they learn via their technical advisors. More information on the TAG program can be found at http://www.epa.gov/superfund/tools/tag/.

2 Remedial Investigation

Section 2 of the RS for OUs 1 and 2 included the following subsections:

- *2.1 Sources of PCBs*
- *2.2 Aroclor 1242 vs. 1254*
- *2.3 Time Trends Analysis*
- *2.4 Validity of Interpolated PCB Maps*
- *2.5 Evaluation Based on New Little Lake Butte des Morts Data*
- *2.6 Scour and Hydrology*
- *2.7 Lower Fox River Dams*
- *2.8 Adequacy of Data Collected to Support the RI/BLRA/FS*

The RS for OUs 3, 4, and 5 follows the same general organization as the RS for OUs 1 and 2. However, many of the comments addressed in the RS for OUs 1 and 2 were generally applicable to the entire Lower Fox River and Green Bay Site and so are not repeated here. Because there are no new comments associated with Sections 2.2, 2.3, 2.5, and 2.7, those sections are not included in the RS for OUs 3, 4, and 5. Prior comments associated with those sections can be found in the RS for OUs 1 and 2, which is available on the WDNR website, in the various information repositories, and in the Administrative Record for the Site. The WDNR's website address is: http://www.dnr.state.wi.us/org/water/wm/lowerfox/rifs/index.html.

Section 2 of the RS for OUs 1 and 2 included Master Comments 2.1 to 2.28. Master Comment 2.29 is therefore the first comment in the RS for OUs 3, 4, and 5.

2.1 Sources of PCBs

Master Comment 2.29

The commenter believes that the WDNR should apply the sediment subarea approach taken in the 1999 draft Feasibility Study during evaluation of risks and selection of remedial alternatives. The commenter believes that OU 4 should not be treated as a single Operable Unit because of site-specific differences between the upstream and downstream portions of the reach.

Response

Following careful review of the comments about splitting OU 4 into two portions, the WDNR and EPA did not find compelling reason to change the current definition of OU 4. OU 4 is first defined in the RI. The physical and chemical characteristics of OU 4 are also discussed throughout the *Baseline Human Health and Ecological Risk Assessment for the Lower Fox River and*

Green Bay, Wisconsin (BLRA), which identifies the risks posed to human health and the environment by chemicals of concern, and the FS, which develops and evaluates a range of remedial alternatives to support the selection of a remedy that will eliminate, reduce, and/or control these risks. The basis for defining OU 4 as a single River reach consists of the following points:

- A large and continuous layer of soft sediment is present from the De Pere dam to the River mouth. Contamination is generally continuous across this Operable Unit. There is no discontinuity or physical change to clearly indicate that the subareas should be considered separately.

- Remediation would be continuous across the existing definition of the Operable Unit. Dividing OU 4 could needlessly complicate remedial activities.

- There are no more dams downstream of the De Pere dam.

- Previous research and modeling, including the Green Bay Mass Balance Study (GBMBS), considered this area as a single model unit.

- Defining OU 4 as a single River reach is consistent with the definitions of other OUs, including OU 1 and OU 3.

An independent panel of university professors and scientists (the Appleton Paper, Inc., Panel, referred to as "the API Panel") evaluated the Proposed Plan and completed a report dated January 17, 2002, and entitled *Ecosystem-Based Rehabilitation Plan – An Integrated Plan for Habitat Enhancement and Expedited Exposure Reduction in the Lower Fox River and Green Bay* (Panel Report). This report also pointed out many similarities between upstream and downstream portions of OU 4, including:

- Similar flow velocities
- Subjection to seiche effects
- Substrate that is predominately soft sediment

In addition, the WDNR demonstrated in the Model Evaluation Workgroup's *Technical Memorandum 2g: Quantification of Lower Fox River Sediment Bed Elevation Dynamics through Direct Observations* (July 23, 1999) that the riverbed in OU 4 is dynamic throughout the OU and that it is incorrect to characterize OU 4 as a continuous depositional area.

Master Comment 2.30

Several comments concerned differences in the extent of sediments in areas of OU 4 and that some areas of OU 4 contain less sediment and are more consistently depositional than others. A commenter suggests that a substantial portion of the dredging costs for OU 4 would be incurred in downstream portions.

Response

As previously noted, following careful review of comments about splitting OU 4 into two portions, the WDNR and EPA did not find a compelling reason to change the current definition of OU 4. See the response to Master Comment 2.29 for a discussion of the Agencies' reasoning.

With respect to dredging costs at OU 4, the WDNR and EPA believe that there is no compelling reason to separate costs at this stage in the remedial process. Cost estimates are prepared on an OU basis, and the costs associated with the 1 ppm cleanup level at OU 4 were reviewed again as part of the WDNR's and EPA's evaluation of comments on the RI/FS and Proposed Plan. In addition, to ensure that cost estimates were adequate, the WDNR prepared *White Paper No. 23 – Evaluation of Cost and Implementability of Alternative C2B for Operable Unit 3 and Operable Unit 4* to review technical and cost issues associated with the Proposed Plan for OUs 3 and 4.

The cost for separate dewatering and disposal facilities is greater than was estimated in the Proposed Plan, but less than what was estimated in the final FS. The cost estimate to remediate OUs 3 and 4 has increased from $200.5 million to $284 million, although some cost savings may yet be identified in the remedial design phase. The WDNR believes, based on EPA guidance, that the estimated cost for remediating OU 4 is representative and adequate (within –30 to +50 percent) for this stage of the Superfund process regardless of how the remedial design for OU 4 is staged.

2.4 Validity of Interpolated PCB Maps

Master Comment 2.31

A commenter stated that the RI appears to have erroneously added over one million cy (1,219,787 cy) of sediment to the total volume of contaminated sediment in OU 4.

Response

Sediment volume data are provided in the RI for each Sediment Management Unit (SMU). In OU 4, the entire surface area of the River bottom is addressed

by the various SMU designations, and there are no significant inter-deposit areas. The Agencies have reviewed the sediment volumes for OU 4; the sediment volume estimates are accurately reflected in Table 5-13 of the RI.

Master Comment 2.32

A commenter expressed concern regarding the following statement in the Proposed Plan: "Approximately 70 percent of the total PCB quantity discharged into the River has migrated into Green Bay." The commenter believed that the statement is not accurate because it assumes that all discharged PCBs not currently in the River must be in Green Bay.

Response

The intent of this statement was to follow through on the finding of the Lake Michigan Mass Balance Study that up to 70 percent of the PCBs ultimately entering Lake Michigan on an annual basis come from the Lower Fox River. Wording has been modified in the ROD.

2.6 Scour and Hydrology

Master Comment 2.33

A commenter remarked that: (1) the downstream portion of OU 4 is not subject to shallow-water erosion effects, (2) bathymetric surveys performed by the United States Army Corps of Engineers (USACE) have been misinterpreted, and (3) scour has not occurred over the last 30 to 40 years and is unlikely to occur in the future.

Response

Comments relating to interpretations of bathymetric data and shallow-water erosion effects were previously addressed in Master Comments 2.20 through 2.24 in the RS for OUs 1 and 2. As discussed there, the WDNR's investigation of sediment bed elevation change is not a misinterpretation of the USACE bathymetric survey data in regard to elevation changes resulting from dredging activities as opposed to scouring. Technical Memorandum 2g (in the Model Documentation Report) discusses the possibility of measurement error contributing to apparent elevation changes. This possibility has been further investigated using actual field data collected by the USACE at the SMU 56/57 demonstration site in August 1999. These data show the combined vertical accuracy (both equipment and procedural) achieved by the USACE, Kewaunee Office to be on the order of ±4 centimeters (cm) for their mapping work on the Lower Fox River, which is well within the 15-cm requirement for Class I hydrographic surveys.

Geographical information system (GIS)-aided analysis of bed elevation changes in the upstream half of OU 4 (De Pere dam to the turning basin) using 1997, 1998, and 1999 USACE hydrographic survey data shows that large areas of the navigation channel undergo between 15 and 30 cm of scour even at non-spectacular flows. EPA Fully Integrated Environmental Location Decision Support (FIELDS) staff also reevaluated their analysis of USACE data; their findings are discussed in *White Paper No. 3 – Fox River Bathymetric Survey Analysis*, which is included in the ROD for OUs 1 and 2. White Paper No. 3 concludes that both erosion and depositional forces are continually changing the sediment bed throughout OU 4. Given this direct evidence about the nature of sediment bed elevation dynamics in OU 4, the WDNR feels that there is significant potential for the scouring of PCB-laden sediments given the timescale of natural recovery.

Changes in Lake Michigan water levels, and therefore Green Bay water levels, result in increasing scour to sediments in OU 4 (LTI, 2002). As a result of changes in global climate, elevations in Lake Michigan are expected to be lower through this century (EPA, 2000). Recent climate models indicate that Lake Michigan water levels could decrease by 3 feet by 2050 and by 4.5 feet by 2090, below historical low water levels (Lofgren et al., 2002; Mortsch, 1998).

In that event, resulting erosional effects would occur throughout OU 4, but would likely be more acute within the lower stretch of the River into Green Bay. Therefore, it is the position of both the WDNR and EPA that the sediments of the Lower Fox River do not represent a secure location for the long-term storage of PCBs. In addition, decisions concerning remediation, such as capping, should take into consideration potential future declines in Lake Michigan water levels that could affect water levels within the Lower Fox River and Green Bay.

References

EPA, 2000. *Preparing for a Changing Climate: The Potential Consequences of Climate Variability and Change, Great Lakes – A Summary by the Great Lakes Regional Assessment Group for the U.S. Global Change Research Program*. United States Environmental Protection Agency, Office of Research and Development, Global Research Program. October.

Lofgren, B. M. et al., 2002. Evaluation of potential impacts on Great Lakes water resources based on two GCM climate scenarios. *Journal of Great Lakes Research*. 28:537–554.

LTI, 2002. *Measurement of Burial Rates and Mixing Depths Using High Resolution Radioisotope Cores in the Lower Fox River*. In: *Comments of the Fox River Group on the Wisconsin Department of Natural Resources' Draft Remedial Investigation, Draft Feasibility Study, Baseline Human Health and Ecological Risk Assessment, and Proposed Remedial Action Plan, Appendix 10*. Prepared by Limno-Tech, Inc., Ann Arbor, Michigan.

Mortsch, L., 1998. Assessing the impact of climate change on the Great Lakes shoreline wetlands. *Climatic Change*. 40:391–416.

Master Comment 2.34

A commenter stated that the RI/FS and Proposed Plan overstate seiche effects and cited the RI as saying "the seiche occurs daily…" in OU 4. The commenter believes that the United States Geological Survey (USGS) data used were inaccurate.

Response

Section 3 (p. 33) of the RI states, "The seiche occurs daily, and, as evidenced by the Acoustical Velocity Meter (AVM) bay data, results in reversed stream flows in the lower reach of the river (Smith et al., 1988)."

The commenter appears to have misconstrued the definition of a seiche. The seiche — meaning the resonant oscillation of the water — does in fact occur daily and does involve flow reversals. However, depending upon the specific magnitude of the seiche, a flow reversal may or may not be observed by the AVM. For example, USGS hydrograph data document significant flow reversals on November 10, 1998; November 28, 1998; and December 13, 1999, at which time a flow reversal was recorded by the USGS during water column monitoring associated with the SMU 56/57 remediation project (USGS, 2000). The USGS maintains that the Lower Fox River has ever-changing flow and depth oscillation commonly associated with estuaries, and flow reversals such as the one that occurred on December 13, 1999, are common. During the SMU 56/57 project, the USGS AVM data varied by more than 4.2 feet. These increases in flow velocity of the Lower Fox River increase sediment resuspension to the fourth power (Jepsen et al., 1997). Flow, being the direction of the path of the water, does reverse itself, resulting in a seiche. The important point is that the seiching frequencies and velocities of the Lower Fox River do influence the nepheloid layer, resuspending previously deposited sediments.

References

Jepsen, R., J. Roberts, and W. Lick, 1997. Effects of bulk density on sediment erosion rates. *Water, Air and Soil Pollution*. 99:21–31.

Smith, P. L., R. A. Ragotzkie, A. W. Andren, and H. J. Harris, 1988. *Estuary Rehabilitation: The Green Bay Story*. University of Wisconsin Sea Grant Program Reprint (WIS-SG-88-864). Reprinted from *Oceanus*, 31(3):12–20.

USGS, 2000. *A Mass-Balance Approach for Assessing PCB Movement During Remediation of a PCB-Contaminated Deposit on the Fox River, Wisconsin.* Jeffrey J. Steuer. United States Department of the Interior, United States Geological Survey. December.

Master Comment 2.35

Commenters stated that Lake Winnebago functions as a large flood control reservoir that attenuates the severity of floods in the Lower Fox River.

Response

Dams at Menasha and Neenah control the Lake Winnebago water level. The dam and lock systems in place in the Lake Winnebago-Lower Fox River system are managed using the Linde Plan (USACE, 1998a) as a management guide; the dam and lock systems are primarily intended to provide water for hydropower and navigation while preserving or enhancing fish, wildlife, and wetland habitat and water quality in the Lower Fox River and the Lake Winnebago pool. The USACE Great Lakes Hydraulics and Hydrology Branch of the Detroit District has regulated the water level of Lake Winnebago using the Linde Plan since the early 1980s, and the target level represents a compromise reached between the needs of hydropower generation and navigation, not flood control.

Flooding can cause an erosive force that could influence hydrodynamic characteristics of the Lower Fox River Site. The issue of Lower Fox River dams and their potential to impact remedial considerations is addressed further in the RS for OUs 1 and 2 (Section 2.7) and *White Paper No. 4 – Dams in Wisconsin and on the Lower Fox River*.

USACE data indicate that rises in the Lake Winnebago water levels do commonly occur, resulting in the flooding of adjacent reaches (e.g., the Lower Fox River). Lake Winnebago water levels follow a seasonal pattern, rising in the spring, declining in the summer, staying level in the autumn, and declining again in the winter. However, floods have occurred during all seasons of the year in the adjacent reaches of the Wolf, Upper, and Lower Fox rivers and along the shores of Lake Winnebago. The most extensive flooding occurs in the spring, when inflows resulting from rainfall, snowmelt, and rainfall accompanied by snowmelt result in a gradual and sustained rise in the level of Lake Winnebago over a period of a few days to more than a week.

Management of Lake Winnebago pool elevation (as observed at Oshkosh) includes a maximum elevation that is not to be exceeded. If the maximum elevation is exceeded, flooding of communities and property adjacent to Lake Winnebago can be expected. If the maximum elevation is experienced, additional water is released through the Neenah and Menasha dams. Therefore, management of Lake Winnebago pool elevation does not represent unlimited storage capacity. Regulation of the water level cannot eliminate flooding potential in the Lower Fox River and may actually increase scour potential through the increased duration of high flows and the gradual release of floodwaters stored in Lake Winnebago.

Abrupt rises in the water level of Lake Winnebago do occur; rises have been associated with:

- Localized heavy precipitation on the water surface, causing a rapid rise in water elevation
- Flooding in the Lake Winnebago pool and/or the Lower Fox River (due to high outflows) during the snowmelt
- Frazil ice that clogs hydropower and industrial water intakes, causing plants to shut down and thus resulting in upstream flooding and reduction of downstream flow
- Wind actions (northeast, east, or southeast) causing a condition referred to as "wave run-up," which is a wave action causing flooding and erosion

Flooding of the Lower Fox River generally requires several days to develop. The graphical representations in Figures 1 and 2 from the USACE website (http://www.lre.usace.army.mil/index.cfm?chn_id=1072#Flood) indicate increases in the outflow of Lake Winnebago. Note that in the 1998 to 1999 period, maximum outflow for July indicates an event in which large water volume releases occurred from Lake Winnebago in an abrupt discharge, which suggests concern for flooding and excessive erosive force in the Lower Fox River.

Figure 1 Graphical Representation of Lake Winnebago Stages Comparing 2003 Levels vs. 2002 Levels in feet, Oshkosh

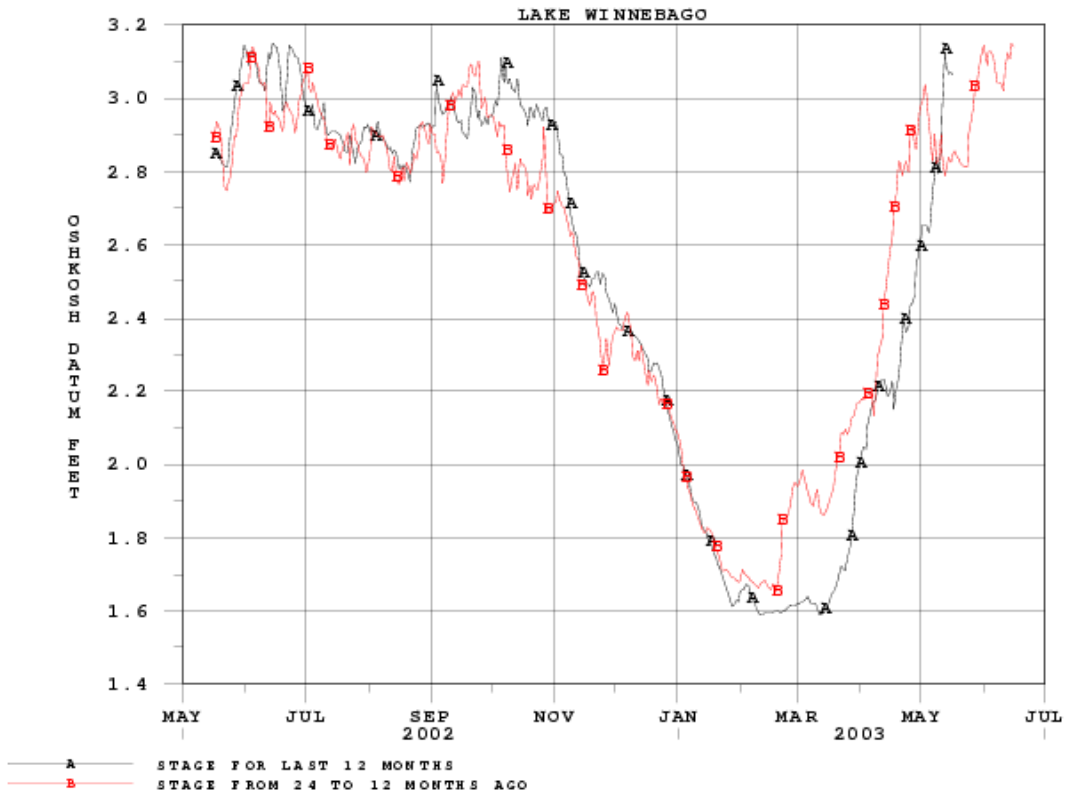
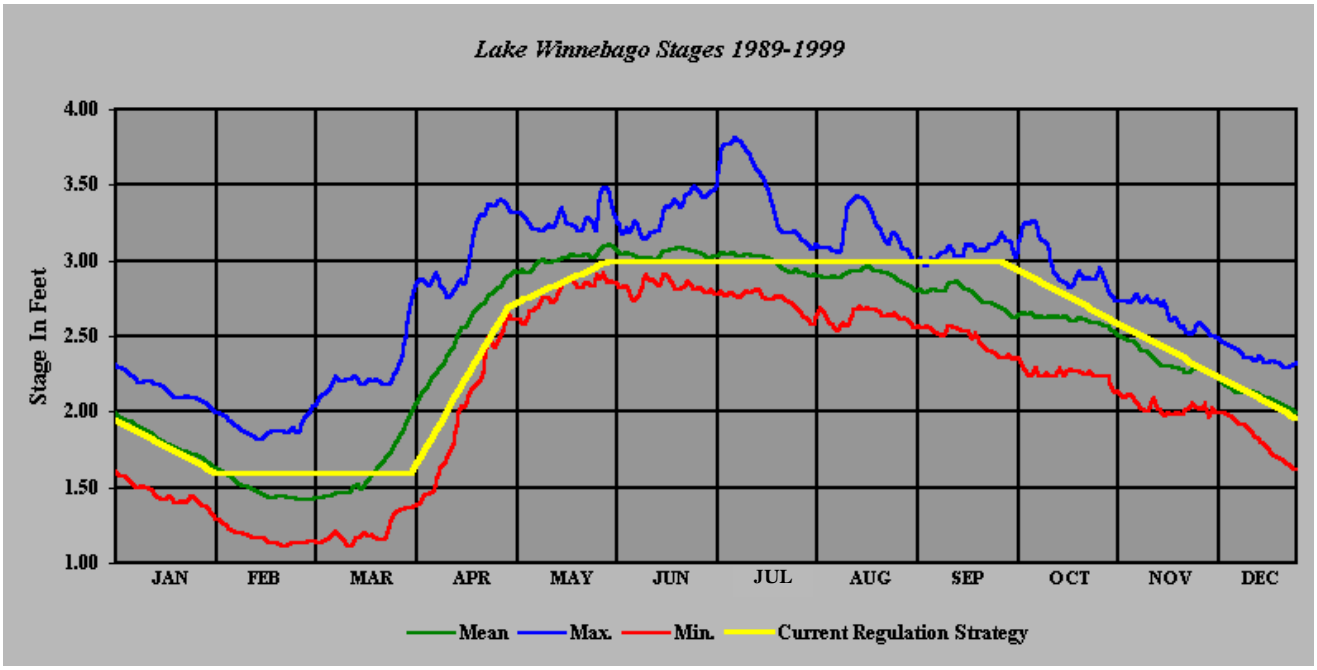


Figure 2 Graphical Representation of Lake Winnebago Mean, Maximum, Minimum, and Current Regulation Strategy for the 1989 to 1999 Period



References

USACE. United States Army Corps of Engineers Internet publication on Lake Winnebago Flooding at: http://www.lre.usace.army.mil/index.cfm?chn_id=1072#Flood.

USACE, 1998a. *Lake Winnebago Facts Book*. United States Army Corps of Engineers Internet publication at: http://www.lre.usace.army.mil/index.cfm?chn_id=1091&CFID=837994&CFTOKEN=44789620.

USACE, 1998b. *Great Lakes Erosion Fact Sheet.* United States Army Corps of Engineers Website: http://www.lre.usace.army.mil/index.cfm?chn_id=1131. August 10.

2.8 Adequacy of Data Collected to Support the RI/BLRA/FS

Master Comment 2.36

Commenters stated that past sampling in the downstream section of OU 4 was biased to nearshore areas, with minimal sampling in the dredged channel.

Response

A majority of the samples collected did focus on areas outside of the navigation channel in this portion of OU 4. The most thorough characterization of OU 4 occurred in 1995 during a project implemented by the Fox River Coalition. Areas outside of the navigation channel were specifically targeted, because information from samples taken within the area that had undergone routine dredging by the USACE would be of limited value. The purpose of the characterization was to document the lateral and vertical extent of contamination; because significant amounts of sediment have accumulated adjacent to the navigation channel, these areas were targeted. Furthermore, information from these areas provides data on the degree and extent of contamination from areas not affected by navigational dredging.

The analysis of data for the Lower Fox River did involve both a screening of historical data and interpolation of the data for each River reach. The methodology for mapping property distributions was developed jointly by the WDNR and the Fox River Group (FRG) and was documented in Technical Memorandum 2e in the Model Documentation Report. In order to use the most recent data available, the data were assigned to three different time periods: 1989 to 1992, 1993 to 1995, and 1996 to 1998. All of the data from the 1996 to 1998 period were considered sufficiently recent for use in the interpolation. As detailed in the RI, the sample frequency distribution and PCB results for each sediment deposit/SMU group/zone are plotted on Figure 5-1 of the RI, which illustrates where sediment samples have been collected and where elevated PCB concentrations have been detected. Sediment bed properties and bed mapping are further discussed in the RI. All areas of the Lower Fox River, including nearshore areas that were characterized as having soft sediments, were included in the mass and volume estimates.

Master Comment 2.37

Commenters expressed concern over the quantity and quality of the data for OU 5, including a concern that data gaps exist regarding the fate and transport of PCBs and the resulting PCB mass estimates in OU 5. A commenter

requested permission to submit additional comments in the future if estimates of PCB mass and contaminated sediment volumes are revised for the Bay.

Response

The *Data Management Summary Report* (DMR), which is appended to the RI, identifies data sets used in the RI and explains how data quality issues were addressed. The EPA conducted an independent peer review of the data that evaluated whether the quality and quantity of the data are adequate to support remedial decisions. The peer review concluded that the data quality and quantity were adequate for making remedial decisions.

The Agencies recognize that uncertainties are associated with all present estimates of PCB mass and sediment volume in Green Bay and acknowledge that it is possible to develop multiple, apparently conflicting, mass and volume estimates. How the assembled data were used to generate PCB mass and sediment volume estimates for the River and Bay is explained in Technical Memoranda 2e and 2f, respectively, which are included in the Model Documentation Report. These memoranda discuss factors contributing to the mass and volume estimates, such as sediment occurrence, the depth of contamination in the sediment column, the concentration of PCBs throughout the sediment column, the bulk density of the contaminated sediments, the chronology of the sediment samples, and the interpolation model used.

The Agencies believe that Technical Memorandum 2f provides a reasonable upper-bound estimate of PCB mass in Green Bay. At the same time, a lower estimate of PCB mass and contaminated sediment volume can be obtained by interpolating based on the minimum possible values for each of the above-listed variables. The WDNR has reevaluated the data and methods used in Technical Memorandum 2f; the procedures and results of this work are discussed in *White Paper No. 18 – Evaluation of an Alternative Approach of Calculating Mass, Sediment Volume, and Surface Concentrations in Operable Unit 5, Green Bay*.

Despite the evaluations in Technical Memorandum 2f and White Paper No. 18, the WDNR conducted additional sampling in the southern part of Green Bay in responding to this and other comments and also considered additional data submitted during the comment period. The procedures and results of this work are discussed in *White Paper No. 19 – Estimates of PCB Mass, Sediment Volume, and Surface Sediment Concentrations in Operable Unit 5, Green Bay Using an Alternative Approach*. White Papers No. 18 and No. 19 demonstrate that the methods for calculating mass and volume are consistent and that the uncertainty regarding lower and upper bounds resides in the data used and in the areal extent and depth to which estimates are made for Green Bay.

The additional data and analyses do indicate a need for further consideration of Green Bay risks. Therefore, the final remedy for Green Bay includes additional analyses to ensure that the remedy decision is protective. If these evaluations indicate that the remedy should be reconsidered, the WDNR and EPA would issue a Proposed Plan recommending a different approach for Green Bay. Such a process would also include a public comment period prior to the issuance of a ROD Amendment by the Agencies.

Master Comment 2.38

Several commenters expressed concern about mass and volume estimates for total PCBs in OU 5, Green Bay. Specifically citing work conducted by University of Wisconsin researchers under the Green Bay Mass Balance program, the concern was that the WDNR overestimated the mass and volume by as much as 4.5 times.

Response

The WDNR and EPA recognize that there is uncertainty associated with any estimate of PCB mass and contaminated sediment volume in Green Bay. The Agencies further acknowledge that it is possible to develop a variety of PCB mass estimates for Green Bay depending on the assumptions and data used to generate base maps. The estimates of PCB mass in the Lower Fox River and Green Bay included in the RI/FS were generated from Technical Memoranda 2e and 2f, respectively, which are included in the Model Documentation Report.

The Agencies did confer with the University of Wisconsin researchers who previously conducted a mass balance estimate for Green Bay. On the basis of detailed discussions of the data with those researchers, the area covered in their estimates, and the exact method of mass determination, the WDNR staff was able to replicate the mass as previously reported by those researchers (Manchester-Neesvig et al., 1996).

Once the WDNR staff was confident it could replicate the work of the University of Wisconsin researchers, it was possible to conduct a side-by-side evaluation of the two methods used for estimating the mass and volume of PCBs in Green Bay. The procedures and results of this work are discussed in *White Paper No. 18 – Evaluation of an Alternative Approach of Calculating Mass, Sediment Volume, and Surface Concentrations in Operable Unit 5, Green Bay*.

The general findings of White Paper No. 18 are that the approaches used in Technical Memorandum 2f and by the University of Wisconsin researchers are both valid and have a good deal of similarity in the way mass and volume are estimated. The findings of White Paper No. 18 include:

- When parameters such as data, aerial coverage, and depth are equalized, the methods used by the University of Wisconsin and in Technical Memorandum 2f have similar results.

- The University of Wisconsin mass and volume estimates are lower than the previous estimates in part because they do not include any data from south of Long Tail Point. Subsequently, based on the receipt of new information from that area, more accurate mass and volume estimates have been made. These estimates are identified in White Paper No. 18 and *White Paper No. 19 – Estimates of PCB Mass, Sediment Volume, and Surface Sediment Concentrations in Operable Unit 5, Green Bay Using an Alternative Approach.*

- The University of Wisconsin mass and volume estimates were made using a more limited data set. The University of Wisconsin estimates were based only on those data for which there are synoptic measurements of PCB concentration and bulk density values. This resulted in the exclusion of some data that show PCB concentrations at depths greater than were used in the University of Wisconsin effort.

- The use of data from greater sediment depths leads to large increases in estimates of the volume of PCB-contaminated sediment.

- In addition to bulk density and PCB concentration, other parameters such as depth of analysis and extent of coverage also factor into PCB mass and contaminated sediment estimates.

- The PCB surface concentrations for the Green Bay zones are similar regardless of the method used.

The Agencies have concluded from these results that the differences in PCB mass estimates between the two methodologies do not result from the process or mathematical models, but depend on which data were included in the interpolation. Furthermore, the Agencies determined that the PCB mass estimates derived in White Paper No. 18 following the University of Wisconsin methodology likely represent a sound estimate of PCB mass in Green Bay.

In July 2002, the WDNR and EPA collected additional data from Green Bay; those data have been incorporated into new PCB distribution maps included in White Paper No. 19. The estimates of PCB mass and volume presented in White Paper No. 19 are based on the alternative methods outlined in White Paper No. 18. These estimates of PCB mass and contaminated sediment volume in Green Bay are 14,565 kg (32,116 pounds) and approximately 266,000,000 cubic meters (350,000,000 cy), respectively. The results of

White Paper No. 18 and White Paper No. 19 are part of this Responsiveness Summary.

Upon completion of the work outlined in White Paper No. 18 and White Paper No. 19, the results were discussed with University of Wisconsin researchers.

Reference

Manchester-Neesvig, Jon B., Anders W. Andren, and David N. Edgington, 1996. Patterns of mass sedimentation and deposition of sediment contaminated by PCBs in Green Bay. *Journal of Great Lakes Research*. 22(2):444–462.

Master Comment 2.39

Commenters suggested that estimates in the Proposed Plan of 30,000 kg (66,000 pounds) of PCBs in the Lower Fox River and 69,000 kg (152,000 pounds) of PCBs in Green Bay are not accurate. The FRG estimates there are 29,000 kg (64,000 pounds) of PCBs in the Lower Fox River and 18,000 kg (39,700 pounds) in Green Bay. The FRG believes that its estimates mean that today, 30 years after PCB releases have essentially stopped, PCBs are buried in significant portions of the River sediment and are not at all being flushed to the Bay.

Response

The Agencies' estimates of PCB mass in the Lower Fox River and Green Bay are generated from Technical Memoranda 2e and 2f, respectively, which are included in the Model Documentation Report. The difference between WDNR and FRG estimates of PCB mass in the River is small. The Agencies have reevaluated the data and methods used in Technical Memorandum 2f to estimate the PCB mass and contaminated sediment volume. In *White Paper No. 18 – Evaluation of an Alternative Approach of Calculating Mass, Sediment Volume, and Surface Concentrations in Operable Unit 5, Green Bay*, the WDNR evaluates different factors for the estimation of PCB concentration distribution, mass, and volume in Green Bay and includes July 2002 data from southern Green Bay in Bay and mass estimates. In *White Paper No. 19 – Estimates of PCB Mass, Sediment Volume, and Surface Sediment Concentrations in Operable Unit 5, Green Bay Using an Alternative Approach*, the WDNR employed the alternative approach described in White Paper No. 18 to produce estimates based on the additional data collected from Green Bay and addressed concerns about the relative lack of PCB sediment data for southern Green Bay.

The WDNR and EPA disagree with the FRG that all PCB mass in the River is buried. Numerous studies (e.g., Technical Memorandum 2f and the FIELDS

Team's *White Paper No. 3 – Fox River Bathymetric Survey Analysis*) have identified the riverbed as dynamic, and water column samples continue to show exceedances in water quality standards for PCBs, indicating that a source remains.

3 Risk Assessment

Section 3 of the RS for OUs 1 and 2 included the following subsections:

- *3.1 Baseline Human Health Risk Assessment*
- *3.2 Baseline Ecological Risk Assessment*
- *3.3 Peer Review Process and Response*
- *3.4 Sediment Quality Thresholds*

The RS for OUs 3, 4, and 5 follows the same general organization as the RS for OUs 1 and 2. However, many of the comments addressed in the RS for OUs 1 and 2 were generally applicable to the entire Lower Fox River and Green Bay Site and so are not repeated here. Because there are no new comments associated with Section 3.3, that section is not included in the RS for OUs 3, 4, and 5. Prior comments associated with that section can be found in the RS for OUs 1 and 2, which is available on the WDNR website, at the various information repositories, and in the Administrative Record for the Site. The WDNR's website address is: http://www.dnr.state.wi.us/org/water/wm/lowerfox/rifs/index.html.

Section 3 of the RS for OUs 1 and 2 included Master Comments 3.1 to 3.21. Master Comment 3.22 is therefore the first comment in the RS for OUs 3, 4, and 5.

3.1 Baseline Human Health Risk Assessment

Master Comment 3.22

Commenters stated that the BLRA overestimates the toxicity of PCBs in OU 4 because:

- The BLRA relied on toxic values calculated from animal studies and ignored evidence from more than 20 human epidemiological studies.
- The high-intake consumer threshold was added, because WDNR estimated that many of the recreational angler exposure thresholds would be met within 30 years without implementation of an active remedy.
- The risk assessment did not adequately differentiate risk in the upstream portion of OU 4 from risk in the downstream portion of OU 4.

Response

The Agencies addressed these general issues in Master Comment 3.1 of the RS for OUs 1 and 2. As stated there, the Agencies concluded that the use of EPA-derived toxicity criteria is appropriate for the human health risk assessment. These values were developed according to standard methodologies and, therefore, present a relative measure of the potential for adverse effects. Both the cancer slope factor (CSF) and the reference dose (RfD) used in the Lower Fox River human health risk assessment were also used by the EPA in the Hudson River risk assessment, where PCBs were also the primary contaminant of concern. In defense of these values, the EPA has prepared white papers on PCB carcinogenicity and noncancer toxicity as part of the Hudson River Responsiveness Summary Record of Decision (EPA, 2002); both of those white papers are attached to the RS for OUs 1 and 2. These white papers include reviews of new epidemiological and toxicological information, which is also summarized in the Hudson River Responsiveness Summary (Master Comments 571 and 541) (EPA, 2002). Specifically, the EPA defended its use of the current RfD for Aroclor 1254 (2×10^{-5}) based on EPA guidelines for selecting preferred toxicity values that are used in risk assessment (EPA, 1989) and because at the time that the RfD was developed, the information was both internally and externally peer-reviewed (EPA, 1993).

Comments received on the human health portion of the BLRA did not question the use of the CSF, but did question the use of the RfD. On behalf of the FRG, AMEC, an engineering services company, recommended that the RfD be 10 times higher (2×10^{-4}) based on the application of revised uncertainty factors associated with the extrapolation from effects in monkeys to effects in humans (AMEC, 2002). This revision was based on an analysis of human data and a comparison of human data to monkey data. The human data came from two capacitor manufacturing plants in New York State where workers had been exposed to Aroclor 1254. The two uncertainty factors that they recommended reducing were related to the extrapolation of subchronic to chronic data and for interindividual sensitivity. Currently, the EPA is conducting a reassessment of the noncancer health effects of Aroclor 1254; however, this reassessment has not been completed and it is not appropriate to use a reference dose that has not been adopted by the EPA. Preliminary findings of the reassessment indicate that the use of animal-to-human uncertainty factors is appropriate, citing results of studies that support greater sensitivity in humans than monkeys.

Use of the lower, current EPA-published reference dose is also supported in the Agency for Toxic Substances and Disease Registry's *Toxicological Profile for Polychlorinated Biphenyls (PCBs)* (ATSDR, 2002). This document presents detailed information from several studies that illustrate increased weight-of-evidence of noncancer effects (such as developmental, reproductive, immunological, and neurobehavioral effects) of PCBs at very

low doses, especially in children (including fetuses and nursing infants). Inclusion of the high-intake consumer receptor is appropriate, because it represents an upper end of the population of exposed anglers. This does not overstate the toxicity of PCBs, as the comments suggest; it merely presents an upper-bound estimate of intake.

The WDNR and EPA believe the BLRA adequately differentiates risk for each reach/zone of the exposure area. Six different fish ingestion scenarios were evaluated: reasonable maximum exposure (RME) recreational angler with upper-bound concentrations; RME recreational angler with average concentrations; central tendency exposure (CTE) recreational angler with average concentrations; RME high-intake fish consumer with upper-bound concentrations; RME high-intake fish consumer with average concentrations; and CTE high-intake fish consumer with average concentrations. In addition, exposure point concentrations were calculated separately for each reach of the Lower Fox River and each zone of Green Bay. As previously stated, these various exposure scenarios present the range of PCB intakes, which is independent of PCB toxicity.

References

AMEC, 2002. *FRG's Alternative Human Health Risk Assessment of the Lower Fox River and Green Bay, Wisconsin*.

ATSDR, 2002. *Toxicological Profile for Polychlorinated Biphenyls (PCBs)*. Agency for Toxic Substances and Disease Registry.

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EPA, 1993. *Workshop Report on Developmental Neurotoxic Effects Associated with Exposure to PCBs*. EPA/630/R-92/004. United States Environmental Protection Agency, Risk Assessment Forum, Office of Research and Development, Washington, D.C. May.

EPA, 2002. *Responsiveness Summary Hudson River PCBs Site Record of Decision*. United States Environmental Protection Agency, Region 2 and United States Army Corps of Engineers, Kansas City District. January.

Master Comment 3.23

Commenters stated that there are differing levels of exposure and risks to human health, as well as to ecological receptors, within OU 4. They argued that the downstream section of OU 4 has less habitat and, therefore, there is

less exposure of fish to PCBs in the downstream portion than in the upstream portion. In addition, commenters stated that OU 4B offers less fish area and access than do the upstream portions, thus lowering risks to humans.

Response

The Agencies believe that commenters' statements concerning fish exposure or risk in upstream and downstream OU 4, as well as comments on preferred fishing locations, are in error. Fish species are not confined to either the upstream or downstream portions of OU 4 (i.e., OU 4B or OU 4A); rather, they are exposed throughout the entire reach. Depending on the season and location of food items, the principal sport fish species (walleye, white bass, catfish, yellow perch) can be found in OU 4B. Adult walleye, for example, are frequently found associated with physical structures in OU 4B and pursue gizzard shad, which can be found in all areas of the River.

Concerning fishing location, most of the seasoned anglers attempting to catch larger walleye focus on the shipping channel and associated structures, even during the spawning period, because many large females can be found at these locations. Many of these sites are found in the downstream sections of OU 4B. While it is true that the highest fishing pressure for walleye occurs during the spawning period, anglers also seek walleye at other times of the year, particularly during late summer and fall, when the downriver areas can be especially productive. Furthermore, flathead catfish are sought throughout the summer months and anglers frequently fish for this species from shore along the walkway in downtown Green Bay. White bass and white perch, in particular, are attracted to the many warm-water discharges that can be found in OU 4B, especially during early spring and late fall. In addition, a very popular shore-based fishing point is the breakwater at the mouth of the River on the western shore. On any given day, numerous high-intake fishermen, along with their families, fish along that wall.

For these reasons, the Agencies conclude that managing OU 4 as a single Operable Unit, as discussed in the response to Master Comment 2.29, is also appropriate from a risk standpoint.

Master Comment 3.24

One commenter stated that remediation plans should be created for Green Bay to prevent recontamination of the Lower Fox River. In addition, the commenter felt that because fish freely migrate between Zone 1 (which is OU 4) and Zone 2 of Green Bay, the Bay should be actively remediated so that fish consumption advisories can be lifted in less than 50 years.

Response

The Agencies believe that the appropriate remedial plan for all of Green Bay is Monitored Natural Recovery (MNR). The Agencies are not aware of a mechanism that would result in basin-wide recontamination of the Lower Fox River as a result of sediment transport from Green Bay into the River. While the Agencies agree that some limited sediment transport could occur during seiche events, surface sampling in Green Bay Zone 2, which is described in White Paper No. 19, demonstrated that surface sediment concentrations of PCBs are less than 0.3 ppm. This, combined with other data collected in Zone 2, leads to an estimated surface-weighted average concentration (SWAC) of 262 parts per billion (ppb). Given these more recent data, Zone 2 appears to be at the PCB SWAC level that will be achieved in all reaches of the Lower Fox River after active remediation. Eliminating further River transport of PCBs to Green Bay will further reduce fish exposure to PCBs in Zone 2. Given these new data, the Agencies are planning to reevaluate all remedial alternatives for Green Bay. This evaluation will include reprojecting the 100-year fish tissue PCB concentrations using the information generated in White Paper No. 19. Once this work is completed, the Agencies will make the results public.

Regarding fish migration in Green Bay, the Agencies agree that fish do move freely between OU 4 and Green Bay and that, based on model projections, total PCB fish tissue concentrations for migrating fish do not fall below 60 ppb, the fish consumption advisory level, within the 100-year projections. Several different model scenarios were evaluated using the combined transport and bioaccumulation models. As documented in the Green Bay Food Chain Model (GBFood) appendix to the Model Documentation Report, a projection that combined a 1 ppm RAL in the River with No Action in Green Bay did result in significant reductions of PCB concentrations in fish tissue. For fish that are predominantly resident in OU 4, the PCB levels will drop below 60 ppb, but PCB levels will not fall below the fish consumption advisory level for Zone 2 fish. However, even with active remediation in Green Bay, the 100-year projections did not result in PCB concentrations in fish tissue that would lead to the lifting of fish consumption advisories within 100 years.

The Agencies concluded that because risk reduction goals would not be achieved even with active remediation, MNR, with planned monitoring and reevaluation of progress toward those goals, is the appropriate response for Green Bay. Monitored Natural Recovery should not be construed as "no action." The Long-Term Monitoring Plan (LTMP) being developed by the Agencies uses changes in fish tissue PCB levels as an explicit metric for evaluating progress toward removal of the fish consumption advisories. After the reevaluation of Green Bay described above is completed, projections developed during that reevaluation may be compared to the measured fish tissue PCB concentrations as determined under the LTMP. With the MNR

alternative, if progress is not being achieved, the Agencies can evaluate whether further active actions are warranted.

Master Comment 3.25

A commenter believes that corrections need to be made to include higher fish consumption rates for highly exposed populations, such as subsistence consumers and minorities, and that the "reduction factor" should be removed to protect individuals who do not properly clean and cook the fish.

Response

The WDNR and EPA do not believe that the BLRA needs corrections. The Agencies considered the time to achieve removal of fish consumption advisories, as well as the reduction in impacts to the ecosystem, when developing the BLRA. The exposure estimates used in the BLRA were carefully selected based on the literature as well as on communication with various Agency personnel. The use of the two West et al. (1989, 1993) studies for exposure estimates is further supported because these are regionally relevant data and because the studies were specifically discussed in detail in the EPA *Exposure Factors Handbook* (EPA, 1997). These data were also used to derive fish consumption rates for the Great Lakes Water Quality Criteria.

The number of "high-intake consumers" estimated in the BLRA is actually overstated, which does not affect the resulting calculated risks for a high-intake consumer. Although there may not be adequate data to evaluate specific subpopulations (e.g., low-income, native American), such an evaluation was not an objective of the BLRA. The objective was to estimate risks to a high-intake consumer, regardless of the number of people who fall into that category or what subpopulation they could be grouped into. A comparison of risk estimates based on the Wisconsin survey data (AMEC, 2002) and similar information from studies used in the BLRA indicates that consumption rates and risk estimates are not significantly different.

The WDNR performed an extensive Time Trends Analysis (RI, Appendix B), which indicated that fish tissue concentrations are not consistently declining for species that are routinely consumed by humans. In the absence of statistical confirmation that tissue concentrations are declining, exposure concentrations were assumed to be static. An assumption of declining fish concentrations would have to be well-supported by the data in order to be certain that human health was being adequately protected. Additionally, even if fish concentrations were found to be declining over time, people have potentially been exposed to historically higher concentrations in fish for the past 30 years. Given the uncertainty about whether fish tissue concentrations are declining and the uncertainty associated with how long people may have

been exposed to historically high PCB concentrations, the WDNR used a static point estimate for fish tissue exposure concentrations. It is also important to note that the focused evaluation considered different species of sport fish individually, as well as combined species. This approach was deemed necessary to evaluate and be fully protective of recreational sport anglers who actively fish for certain species (e.g., walleye). Further discussion of the ecological and human health risks related to fish consumption appears in the response to Master Comment 3.23 of this RS.

References

AMEC, 2002. *FRG's Alternative Human Health Risk Assessment of the Lower Fox River and Green Bay, Wisconsin.*

EPA, 1997. *Exposure Factors Handbook (Update to Exposure Factors Handbook – May 1989)*. EPA/600/8-89/043. United States Environmental Protection Agency, Office of Research and Development, Washington, D.C.

West, P. C., M. J. Fly, R. Marans, and F. Larkin, 1989. *Michigan Sport Anglers Fish Consumption Survey*. Technical Report #1. Prepared for Michigan Toxic Substance Control Commission. Natural Resources Sociology Research Laboratory.

West, P. C., J. M. Fly, R. Marans, F. Larkin, and D. Rosenblatt, 1993. *1991–1992 Michigan Sport Anglers Fish Consumption Study*. Technical Report #6. Prepared by University of Michigan, School of Natural Resources for Michigan Department of Natural Resources, Ann Arbor, Michigan. University of Michigan. May.

Master Comment 3.26

A commenter stated that, for OU 4, an alternative human health risk assessment model predicts that the potential human health risk would actually increase slightly under the proposed remedy.

Response

The EPA and WDNR disagree with this statement. The FRG conducted an advanced form of Monte Carlo risk assessment, known as Microexposure Event (MEE) analysis, as the basis for its human health risk assessment (AMEC, 2002). This model was presented in opposition to the analysis presented in the BLRA, which is based on a point estimate as opposed to a probabilistic model (i.e., Monte Carlo). Please see the response to Master Comment 3.8 in the RS for OUs 1 and 2 (WDNR and EPA, 2002) for further discussion of the basis for selecting the risk analysis tools that were used to

assess human health risks from PCB exposure in the Lower Fox River. (Note that the discussion in Master Comment 3.8 covers the entire River and is not limited to an analysis of OU 4.) As with the other models presented by the FRG, the MEE model was not subject to same degree of scientific scrutiny and peer review as was the whole Lower Fox River Model (wLFRM). More information on how the Agencies used models in making decisions can be found in *White Paper No. 9 – Remedial Decision-Making in the Remedy Selection for the Lower Fox River/Green Bay Remedial Investigation, Feasibility Study, and Proposed Remedial Action Plan*, which is part of the RS and ROD for OUs 1 and 2, and *White Paper No. 22 – Remedial Decision-Making for the Lower Fox River/Green Bay Remedial Investigation, Feasibility Study, Proposed Remedial Action Plan, and Record of Decision for Operable Units 3 through 5*.

In addition, the WDNR and EPA disagree with the foundation of this comment, which is that alternative models developed outside the collaborative and peer-reviewed process are better models than those used in the RI/FS. The models (FoxSim and the MEE model) cited by the commenter appear for the first time in the FRG's comments to the RI/FS and do not appear to have been subject to the same degree of scientific scrutiny and peer review as were the RI/FS models. The peer-reviewed process for model development is detailed in Master Comments 6.21 and 9.4 of the RS for OUs 1 and 2.

The Agencies also believe that the "increased human health risk" cited by the commenter is an artifact of worst-case assumptions made about post-removal sediment PCB concentrations and the resultant sediment transport conditions as predicted by FoxSim, not wLFRM. Therefore, the risk assertion is not made on a basis similar to conditions used in the RI/FS. The WDNR did, however, review the FoxSim model. The conclusions of that review can be found in *White Paper No. 15 – FoxSim Model Documentation*, which is part of the RS and ROD for OUs 1 and 2.

References

AMEC, 2002. *FRG's Alternative Human Health Risk Assessment of the Lower Fox River and Green Bay, Wisconsin.*

WDNR and EPA, 2002. *Record of Decision for Operable Unit 1 and Operable Unit 2, Lower Fox River and Green Bay, Wisconsin*. Wisconsin Department of Natural Resources, Madison and Green Bay, Wisconsin and United States Environmental Protection Agency, Region 5, Chicago, Illinois. December.

3.2 Baseline Ecological Risk Assessment

Master Comment 3.27

Commenters expressed concern that the portion of Green Bay known as Zone 2 is used for commercial fishing and that fish caught in Green Bay Zone 2 would be served at restaurants. Furthermore, the commenters do not believe the human health risk assessment has taken this concern into account.

Response

It is correct that there are commercially caught fish in Zone 2. Table 1 summarizes the types of fish targeted and the recorded catches during the 2000 to 2002 period.

Table 1 Commercially Caught Fish in Green Bay Zone 2

Fish	Year (number of fish captured)		
	2000	2001	2002
Lake Whitefish	61,233	71,095	40,298
Menominee Whitefish	22	3	80
Rainbow Smelt	34,280	12,121	680
Yellow Perch	46,148	31,952	18,229

Source: WDNR Bureau of Fisheries Management and Habitat Protection, April 11, 2003.

However, the comment is not correct in asserting that the human health risk assessment does not account for fish potentially consumed in restaurants. Exposure and intake assumptions used in the human health risk assessment are conservative and are consistent with standard and customary EPA approaches (see the first paragraph of the response to Master Comment 3.25 for a discussion of how the exposure estimates used in the human health risk assessment were selected). Although the human health risk assessment does not speak directly to the restaurant consumption of fish commercially caught in Zone 2, it did analyze various consumption scenarios, including high-intake consumption. (In fact, another commenter contends that the number of "high-intake consumers" estimated in the BLRA is overstated. However, that number does not affect the resulting calculated risks for a high-intake consumer.) The objective was to estimate risks to high-intake consumers, regardless of the number of people who fall into this category or what subpopulation they may be part of, including the subpopulation of people who eat fish in restaurants.

Although not directly relevant to the human health risk assessment, the WDNR does currently monitor the fish in Green Bay and issue fish consumption advisories (available at

http://www.dnr.state.wi.us/org/water/fhp/fish/advisories/Index.htm) based on a comparison of PCB tissue concentrations to the Food and Drug Administration (FDA) limits for PCB exposure.

Master Comment 3.28

Commenters expressed the opinion that the ecological risk assessment in the BLRA is weak and inconsistent in stating that PCBs have caused reduced reproduction and increased deformities in Green Bay tern colonies. The commenters noted that tern habitat is limited to the mouth of the River and Renard Island. Studies have shown no current risk to these birds and the United States Fish and Wildlife Service (USFWS) concluded that Caspian terns have not been injured by PCBs.

Response

The Agencies disagree with this comment. Piscivorous birds rely primarily on fish for food. Of the bird populations present at the Site, piscivorous birds represent a high trophic level and, therefore, are more at risk from contaminants transferred through the food chain than are insectivores. Examples of piscivorous birds on the Lower Fox River and Green Bay include cormorants and terns. The BLRA used these species to represent all piscivorous birds that could use the Lower Fox River and Green Bay system.

To avoid confusion between the presence or absence of one species and risk to the entire assessment endpoint, it is important to recognize the distinction between the assessment endpoint and the measurement endpoint. For example, terns and cormorants were evaluated to represent the piscivorous bird assessment endpoint. To that end, adverse impacts to these species (the measurement endpoint) are meant to be representative of adverse impacts to all piscivorous birds (the assessment endpoint), because other species of piscivorous birds that were not specifically evaluated (e.g., gull, heron, egret) must also be protected if they are present. Therefore, it is imperative to be conservative, yet scientifically sound, when translating impacts on a given species to the assessment endpoint. That is, the lack of impact on one receptor species does not mean the assessment endpoint is not at risk. For that reason, the determination of risk to piscivorous bird reproduction and survival is inclusive of all piscivorous birds living and feeding from the Lower Fox River and from Green Bay.

The conclusion of the BLRA is that risk is present to the assessment endpoint. The assessment endpoint in the BLRA is "piscivorous bird reproduction and survival," and is not limited to risk to Caspian terns. The BLRA used several lines of evidence to reach this conclusion. These lines of evidence included modeling the food-chain uptake of contaminants, USFWS studies, and site-specific chemical information.

Master Comment 3.29

Some commenters believe that because of habitat limitations, sediments in areas of OU 4 are unlikely to contribute to PCB body burdens in the fish species preferred by most anglers (walleye, catfish, white perch, white bass, and yellow perch). Commenters stated that carp (which was referred to as an unpalatable "trash fish") is the only species in OU 4 identified by the WDNR as not showing substantially decreasing PCB concentrations.

Response

The species (walleye, catfish, white perch, carp, white bass, and yellow perch) noted in the comments do not confine themselves to subsections of OU 4. Depending on the season and the location of food items, all six of the named species can be found in all sections of OU 4. For examples, see the discussion of fish locations in the response to Master Comment 3.23.

The Time Trends Analysis (RI, Appendix B) does find that carp in OU 4 show a statistically significant increase in PCB concentration. As discussed in Master Comment 3.3 of the RS for OUs 1 and 2, people do eat carp, which is why the finding of increased tissue PCB concentrations is important to the Agencies' goal of protecting human health and the environment. That people consume carp is readily demonstrated by the number of websites dedicated to finding and preparing carp for human consumption (for example, www.carpanglersgroup.org, www.carp.net, www.carpuniverse.com, and www.carpdreamfishing.com).

The decision to proceed with active remediation was based on risk reduction and the time necessary to reduce or eliminate consumption advisories for fish. The Agencies concur that the processes involved in natural recovery are not amenable to an effective and expeditious remediation of the Lower Fox River. Natural processes would take more than 100 years for recovery, whereas a 1 ppm dredging remedy will lead to the removal of fish consumption advisories in an estimated 20 years.

Master Comment 3.30

Commenters expressed concern that no remedy will enable the removal of fish advisories for high-intake consumers (the most restrictive exposure scenario) because of contamination entering the Lower Fox River from Lake Winnebago and Green Bay from the River.

Response

Commenters are correct that fish consumption advisories exist for Lake Winnebago. These advisories, however, are less stringent than those for the

Lower Fox River and Green Bay. For instance, in Little Lake Butte des Morts and the rest of the Lower Fox River, all sizes of carp are "Do Not Eat" and no species of fish fall into the "unlimited" or "once per week" consumption categories. However, Lake Winnebago advisories allow for more frequent consumption of most species ("unlimited" or "once per week") and limit only the consumption of large carp and large channel catfish to 12 meals a year. Lake Winnebago does not have any "Do Not Eat" or "Eat no more than six meals per year" restrictions.

Although it will not be possible to remove all consumption advisories once the remediation is complete, the WDNR and EPA do expect on the basis of computer modeling that as time passes the advisories will, at a minimum, be reduced if not completely eliminated. The WDNR and EPA will also require continued monitoring of fish to determine whether there are reductions in tissue concentrations.

Fish consumption advisories are effective only if fish consumers are aware of and choose to follow the advisory. The WDNR, in cooperation with the Wisconsin Division of Health, will revise the fish consumption advisories for the Lower Fox River and Green Bay according to the Great Lakes Task Force Protocol and will continue to provide that information using a variety of methods (e.g., publications, news releases, Internet sites). In addition, these Agencies plan to continue ongoing educational efforts, such as posting advisories at boat landings and providing literature on advisories in multiple languages.

The WDNR and EPA's objectives are to eliminate consumption advisories for recreational anglers within 10 years and for high-intake fish consumers within 30 years of the completion of remediation.

Master Comment 3.31

Commenters contended that PCBs are not currently a cause of many use impairments or suspected impairments of the Lower Fox River and Green Bay system. Commenters stated that PCBs in the system do not cause: (1) degraded fish or wildlife populations; (2) tainted fish or wildlife flavors; (3) fish tumors or other deformities; (4) eutrophication or undesirable algae; (5) taste, odor, or consumption problems with drinking water; (6) beach closings; (7) the degradation of aesthetics; or (8) the loss of fish and wildlife habitat. Commenters assert that the causes of these impairments include nutrient loadings, suspended solids, stormwater runoff, turbidity, and land development.

Response

Please refer to the response to Master Comment 3.13 in the RS for OUs 1 and 2, which addressed this same issue for OUs 1 and 2 and is equally applicable to OUs 3, 4, and 5.

The WDNR and EPA do not claim that PCBs are the source of all impairments identified in the Proposed Plan for the Lower Fox River and Green Bay. However, the WDNR and EPA do believe that PCBs are the major contaminant contributing to consumption advisories and to unacceptable health risks for those who do not follow the advisories. PCBs are suspected to be an impairment related to degraded fish and wildlife; health-related alterations in fish; the degradation of benthos, as well as of populations of phytoplankton and zooplankton; restrictions placed on dredging activities; and additional costs to industry. The WDNR and EPA also believe: (1) that significant reduction in PCBs in the River will go a long way toward addressing other River impairments that affect use of the Lower Fox River and Green Bay, and (2) that after the PCB problem is addressed, it will make even greater sense to address remaining issues.

Master Comment 3.32

Commenters stated that the BLRA significantly overestimates current and future ecological risks presented by Green Bay because the BLRA does not use the full weight of evidence in quantifying risks for decision-making. Commenters further expressed their preference that the BLRA focus only on PCB congeners that contribute most significantly to ecological risk.

Response

The WDNR acknowledges that numerical weighting of lines of evidence is a type of evaluation that was not used, although it is not the only weight-of-evidence approach. The quantitative weight-of-evidence approach proposed by Menzie et al. (1996) has been used for risk characterization at few, if any, Superfund sites. However, although a numeric evaluation is intended to be more quantitative and explicit in the methods of risk ranking, the rationale for the determination of weighting factors assigned to each measurement endpoint was not clearly described or defended by Blasland, Bouck and Lee in their alternative risk assessment for the Lower Fox River (BBL, 2002). In addition, some of the weighting factors described in BBL (2002) were incorrectly recorded in the tables used to summarize numerical scores.

Both total PCB toxicity and congener-specific toxicity were evaluated in the BLRA. The WDNR and EPA believe that both evaluations were necessary and consistent with risk assessment guidance and with the recommendations of the National Research Council (NRC). For further discussion on this topic,

please also see the response to Master Comment 3.11 in the RS for OUs 1 and 2.

References

BBL, 2002. *Baseline Ecological Risk Assessment of the Lower Fox River and Green Bay, Wisconsin*. Blasland, Bouck and Lee. January.

Menzie, C. M., H. Henning, J. Cura, K. Finkelstein, J. Gentile, J. Maughn, D. Mitchell, S. Petron, B. Potocki, S. Svirsky, and P. Tyler, 1996. Special report of the Massachusetts weight-of-evidence workshop: A weight-of-evidence approach for estimating ecological risks. *Human and Ecological Risk Assessment*. 6:181–201.

3.4 Sediment Quality Thresholds

Master Comment 3.33

A commenter expressed the opinion that the conceptual representation of the PCB problem at the Lower Fox River and Green Bay Site is factually inaccurate and that the Proposed Plan and supporting technical documents overstate the PCB problems.

Response

The WDNR and EPA disagree with this statement. The characterization of the Site defines sources, as well as current Site information and risks. A technical evaluation of remedial technologies is the appropriate level of detail at this point in the Superfund decision-making process. Additional sample collection and analysis will be conducted as part of the remedial design phase. The methods used to estimate PCB mass and contaminated sediment volumes in the River are identified in Technical Memorandum 2e.

4 RAOs, SQT, and RAL Selection

Section 4 of the RS for OUs 1 and 2 included the following subsections:

- *4.1 RAOs*
- *4.2 SQTs and SWACs*
- *4.3 Selection of RAL*

The RS for OUs 3, 4, and 5 follows the same general organization as the RS for OUs 1 and 2. However, many of the comments addressed in the RS for OUs 1 and 2 are generally applicable to the entire Lower Fox River and Green Bay Site and so are not repeated here. The RS for OUs 1 and 2 is available on the WDNR website, at the various information repositories, and in the Administrative Record for the Site. The WDNR's website address is: http://www.dnr.state.wi.us/org/water/wm/lowerfox/rifs/index.html.

Section 4 of the RS for OUs 1 and 2 included Master Comments 4.1 to 4.19. Master Comment 4.20 is therefore the first comment in the RS for OUs 3, 4, and 5.

4.1 RAOs

Master Comment 4.20

Commenters stated that there would be no real benefit to Green Bay from the remedies applied to the River and therefore concluded that remedial action objective (RAO) 4 is arbitrary.

Response

The WDNR and EPA disagree with this comment. RAO 4 provides for reduced PCB transport from the Lower Fox River to Green Bay. The selected remedy will remove PCBs from the River before they are able to migrate to the Bay. Further, the remedy is cost-effective, because it removes PCBs from the River, where they are more accessible for remedial management, rather than from the Bay, where they would be dilute and more expensive to remediate.

As discussed in the RI (Section 5.6), anywhere from 125 to 220 kg (275 to 485 pounds) of PCB mass is exported from the Lower Fox River to Green Bay annually. It is estimated, based on the WDNR's transport models, that there will be a greater than 90 percent reduction in annual loading of PCBs to the Bay if the remediation in the Proposed Plan is implemented.

Active remediation in the River and Bay will reduce long-term risks to human health and the environment. Contrary to the comment, the WDNR's modeling

does show improvements to the Bay. For example, as documented in the FS (Table 8-10), a 1 ppm action level for the River and in the Bay reduces the time to the CTE cancer risk of 10^{-4} to 3 years. This compares to 83 years to achieve this risk level if no action is taken in the River and Bay.

RAO 4 also supports the Lake Michigan Lake-wide Management Plan's (LaMP) basic principle to "reduce loadings and emissions of LaMP critical pollutants to the Lake Michigan ecosystem and remediate contaminated sediments within the 10 Areas of Concern in the Lake Michigan basin; utilize the LaMP process to develop reduction targets (building on the Lake Michigan Mass Balance Study and the Binational Strategy); and achieve substantial reductions in human and ecological health risks in the basin" (EPA, 2000).

Reduction of the contaminant loading from the Lower Fox River to Green Bay and Lake Michigan is a fundamental goal of the remediation in the River and Bay. The remedy will reduce long-term risks to human health and the environment. Please also see the response to Master Comment 4.4 in the RS for OUs 1 and 2 for further discussion on this topic.

Reference

EPA, 2000. *Lake Michigan Lake-wide Management Plan*. United States Environmental Protection Agency Website: http://www.epa.gov/grtlakes/lakemich/.

4.2 SQTs and SWACs

Master Comment 4.21

A commenter stated that the use of SWAC may lead to the selection of a remedy that only appears protective and could result in final remedial action that does not reduce sediment surface concentrations.

Response

The WDNR and EPA disagree with this comment. The basis for the selection of the RAL was identified in the Proposed Plan and is further explained in the ROD. The Agencies gave careful consideration to what approach is needed to be protective and meet the RAOs. The WDNR and EPA chose to use the RAL-based approach for consistency among OUs. For all OUs, the resulting SWAC was evaluated to determine whether the RAL and resulting SWAC are protective of human health and the environment. The 1 ppm RAL and resulting SWAC do result in implementation of a remedy that is sufficient to

meet this standard. The selection of the cleanup level is the outcome of a complete and scientifically based risk evaluation.

Derivation of the RALs, and corresponding SWACs, is discussed in the FS (Section 5). Remedial alternatives were developed for each River reach or Bay zone in the FS (Section 7) and evaluated for cost and risks, as well as compared to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) threshold and balancing criteria (FS, Sections 8 through 10). For the Proposed Plan, the EPA and WDNR selected an RAL of 1 ppm based on careful, deliberate consideration of the permanence, risk reduction, public acceptance, and costs discussed in the FS. In selecting the 1 ppm RAL, the WDNR and EPA considered RAOs, model forecasts of the time necessary to achieve risk reduction, the post-remediation SWAC, comparison of the residual concentration to sediment quality thresholds (SQTs) for human and ecological receptors, sediment volume and PCB mass to be managed, and the cost. This evaluation is discussed further in the ROD.

The WDNR and EPA selected the 1 ppm RAL based on an evaluation of action levels and the residual SWAC for each OU and the ability of the action level to meet the RAOs. The Agencies in particular considered the time to achieve the removal of fish consumption advisories, as well as the reduction in impacts to the ecosystem. The 1 ppm RAL is the best mechanism for achieving these goals consistent with the process identified in the Proposed Plan.

The WDNR and EPA carefully considered more and less stringent cleanup levels (RALs) before arriving at the 1 ppm level. In the FS, no action and multiple RALs ranging from 0.125 to 5 ppm were considered for each OU. The 1999 draft RI/FS called for an action level of 0.25 ppm. Model forecasts were used to compare the projected outcomes of the remedial alternatives using various action levels with the RAOs (primarily RAOs 2 and 3, which deal with protection of human health and the environment). On the basis of that analysis and to achieve the risk reduction objectives using a consistent action level, 1 ppm was agreed upon as the appropriate RAL. As presented in Table 1 of *White Paper No. 11 – Comparison of SQTs, RALs, RAOs and SWACs for the Lower Fox River*, the SWAC in OU 3 and OU 4 at a 1 ppm RAL is equal to or lower than the 0.25 ppm SWAC presented in the 1999 RI/FS. The 1 ppm RAL cleanup standard is a risk-based cleanup standard and is considered protective. The 0.25 ppm level from the February 1999 RI/FS was a preliminary number. The Agencies believe that the 1 ppm RAL is the best mechanism for achieving RAOs and removing fish consumption advisories.

4.3 Selection of RAL

Master Comment 4.22

The commenter believes that the proposed RAL of 1 ppm (1 milligram per kilogram [mg/kg] total PCBs) does not provide enough protection for human, wildlife, or aquatic health to remove fish consumption advisories.

Response

The WDNR and EPA disagree. The Agencies gave careful consideration to what is needed to be protective and meet the RAOs. The selection of the cleanup level is the outcome of a complete and scientifically based risk evaluation. The basis for selecting the RAL was clearly identified in the Proposed Plan and is further explained in the ROD. In selecting the 1 ppm RAL, the WDNR and EPA considered RAOs, model forecasts of the time necessary to achieve risk reduction, the post-remediation SWAC, comparison of the residual concentration to SQTs for human and ecological receptors, sediment volume and PCB mass to be managed, and cost. The WDNR and EPA carefully considered more and less stringent cleanup levels (RALs) before arriving at the 1 ppm level. No action and multiple RALs ranging from 0.125 to 5 ppm were considered for each OU. See the response to Master Comment 4.21.

The Agencies considered the time to achieve the removal of fish consumption advisories, as well as the reduction in impacts to the ecosystem. The exposure estimates used in the BLRA were carefully selected based on the literature as well as on communication with various Agency personnel. See the first paragraph of the response to Master Comment 3.25 for a discussion of how the exposure estimates used in the human health risk assessment were selected.

Master Comment 4.23

A commenter requested that the sediment cleanup standard for PCBs be strengthened to 0.25 ppm in the Bay as well as the Lower Fox River.

Response

The WDNR and EPA believe that MNR is the only feasible option for Green Bay given the limited risk reduction, substantial costs, and difficulties associated with implementing any other solution. In addition, the basis for selecting a 1 ppm RAL for the Lower Fox River was identified in the Proposed Plan and is further explained in the ROD. That selection process is also summarized in the response to Master Comment 4.21, above.

The selected cleanup standard is not arbitrary, and the Agencies gave careful consideration to what is needed to be protective and meet the RAOs. The selection of the cleanup level is the outcome of a complete and scientifically based risk evaluation. The 1 ppm RAL is the best mechanism for achieving RAOs consistent with the process identified in the Proposed Plan.

Master Comment 4.24

A commenter stated that the WDNR's remedy selection ignored OU-specific data by using a generalized value to derive an SQT specific to OU 4 (understanding that the characteristics of OU 1 are very different from OU 4 based on the government's initial work to calculate SQTs) and applying that SQT to the entire River, when water concentrations in OU 4 are 10 times higher than those of OU 1.

Response

In selecting the appropriate action level for OU 1, the WDNR and EPA applied an approach that balanced risk reduction for human health and the environment as well as the residual SWAC and the resulting human health and ecological SQT for each OU. For determination of RALs, the WDNR and EPA also considered cost and long-term effectiveness. For OU 1, the 1 ppm action level resulted in the most appropriate level of risk reduction. Sediment-to-water ratios were developed for all four reaches of the River and for Green Bay. The general term used to estimate SQTs was not from OU 4, as the commenter implies, but rather a value of 10^{-6} was determined to be a good estimation of the range of values observed. As documented in Section 7 of the BLRA, sediment-to-water ratios average between 10^{-4} and 10^{-7} for all Operable Units, with averages of 10^{-5} in OUs 3 and 4 to 10^{-6} in OUs 1 and 2 and Zone 2 of Green Bay. For more information, see Section 9.6 of the Proposed Plan and *White Paper No. 11 – Comparison of SQTs, RALs, RAOs, and SWACs for the Lower Fox River*.

Master Comment 4.25

A commenter stated that approximately 40,000 individuals in the Lower Fox River and Green Bay region are faced with PCB cancer risks similar to the risks of smoking two to three packs of cigarettes a day. This PCB exposure arises primarily through the consumption of contaminated fish and waterfowl.

Response

The WDNR and EPA disagree with this comment. The average smoker has been reported to have a cancer risk of about 1.2 in 1,000; in other words, about one in 1,000 smokers will ultimately develop cancer (Crouch and

Wilson, 1984). As determined in the BLRA, the average consumer of Lower Fox River (OU 4) fish has a cancer risk of 4.9 in 100,000; in other words, possibly five out of 100,000 people who might eat fish could develop cancer (Table 5-82 of the BLRA). These risks are about 25 times lower than the risks of the average smoker.

For the RME recreational angler, the cancer risks rise to 3.3 in 10,000 (Table 5-82 of the BLRA); for a high-intake angler, the cancer risks reach 7.8 in 10,000 (Table 5-86 of the BLRA). While the cancer risks to frequent fish consumers are high and are of concern to the WDNR and EPA, the risks are still lower than those found for average smokers and would be even lower if compared to cancer risks in heavy smokers.

Reference

Crouch and Wilson, 1984. "Inter-Risk Comparisons." In: *Assessment and Management of Chemical Risks*. Joseph Rodricks and Robert Tardiff (eds). American Chemical Society, Washington, D.C.

5 Technical Evaluation and Remedial Alternative Development

Section 5 of the RS for OUs 1 and 2 included the following subsections:

- *5.1 Effectiveness of Dredging*
- *5.2 In-Situ Sediment Caps*
- *5.3 Monitored Natural Recovery*
- *5.4 Remedy Selection*
- *5.5 Evaluation of Submitted Alternatives*

The RS for OUs 3, 4, and 5 follows the same general organization as the RS for OUs 1 and 2. However, many of the comments addressed in the RS for OUs 1 and 2 are generally applicable to the entire Lower Fox River and Green Bay Site and so are not repeated here. The RS for OUs 1 and 2 can be found on the WDNR website, at the various information repositories, and in the Administrative Record for the Site. The WDNR's website address is: http://www.dnr.state.wi.us/org/water/wm/lowerfox/rifs/index.html.

Section 5 of the RS for OUs 1 and 2 included Master Comments 5.1 to 5.70. Master Comment 5.71 is therefore the first comment in the RS for OUs 3, 4, and 5.

5.1 Effectiveness of Dredging

Master Comment 5.71

A commenter stated that the Proposed Plan did not quantify and report uncertainty in sediment bed mapping, volume estimation, and cost-effectiveness calculations.

Response

Supporting documents for the Proposed Plan provided details of uncertainties related to bed mapping and volume estimates. Specifically, Technical Memorandum 2g (Appendix A of the Model Documentation Report) attached to the FS provides a thorough analysis of the potential uncertainties of the bathymetry data. Additionally, *White Paper No. 2 – Evaluation of New Little Lake Butte des Morts PCB Sediment Samples*, attached to the ROD for OUs 1 and 2, also addresses potential uncertainties related to bathymetry data. These analyses support the conclusion that uncertainties related to bed mapping are relatively small and that the data support remedy decisions.

Nonetheless, in order to properly address the issues associated with sediment bed mapping, volume estimation, and cost-effectiveness calculations, the WDNR developed *White Paper No. 18 – Evaluation of an Alternative Approach of Calculating Mass, Sediment Volume, and Surface Concentrations in Operable Unit 5, Green Bay*; *White Paper No. 19 – Estimates of PCB Mass, Sediment Volume, and Surface Sediment Concentrations in Operable Unit 5, Green Bay Using an Alternative Approach*; and *White Paper No. 23 – Evaluation of Cost and Implementability of Alternative C2B for Operable Unit 3 and Operable Unit 4*.

The WDNR performed an alternative analysis of the PCB mass and volume estimates originally presented in *Technical Memorandum 2f: Estimates of Sediment Bed Properties for Green Bay*, which is appended to the Model Documentation Report. White Paper No. 18 was developed to respond to comments from the academic and regulated communities as well as other groups regarding the analytical procedures and assumptions about physical factors used in Technical Memorandum 2f. White Paper No. 18 evaluates a set of different factors on the estimation of concentration distribution, mass, and volume of PCBs in Green Bay.

As part of this evaluation, the WDNR devised a test to directly compare the results of the method outlined in Technical Memorandum 2f with the University of Wisconsin method to determine whether differences in PCB mass and estimates of contaminated sediment volume are attributable to differences between the two interpolation methods. The results of the method evaluation test show that differences between the University of Wisconsin's mass estimate and the mass estimate and contaminated sediment volume presented in Technical Memorandum 2f cannot be attributed to the Inverse Distance Weighting (IDW) interpolation algorithm. When parameters such as data, areal coverage, and depth are equalized, the methods used by the University of Wisconsin and in Technical Memorandum 2f yield similar results. The University of Wisconsin mass and volume estimates are low because they do not include any data south of Long Tail Point.

In addition, White Paper No. 19 employed the alternative approach described in White Paper No. 18 to produce estimates based on additional data collected from Green Bay in July 2002 and to address concerns about the relative lack of PCB sediment data for southern Green Bay. The additional data were collected from areas identified as potential open-water disposal areas.

Finally, the WDNR prepared White Paper No. 23 in response to comments on the Proposed Plan. This white paper addresses and reevaluates issues of implementation and cost-effectiveness concerning OUs 3 and 4.

Master Comment 5.72

Commenters expressed concern regarding resuspension and asserted that the Proposed Plan is unrealistic in that it assumes success at reaching the desired SWAC without recontamination problems associated with sediment resuspension during dredging. The commenters also suggested that dredging will likely result in the greatest short-term, in-River contaminant release and that the demonstration dredging projects have caused sediment resuspension and redistribution.

Response

The WDNR and EPA acknowledge that there will be sediment resuspension during remediation of the Lower Fox River. Currently, estimates of PCB mass export from the River to the Bay under a no action alternative range up to 220 kg (485 pounds) per year. Although short-term increases while dredging is taking place are possible, over the long run there will be a significant reduction (98 percent) in PCB load from the River to the Bay as a result of the remedy.

The Agencies believe that a high-end estimate of losses from dredging is the 2.2 percent estimate from the SMU 56/57 project. Applying the loss rates from that project would equate to a loss of 644 kg (1,420 pounds) of PCBs during the entire remediation of the Lower Fox River. On the other hand, the FRG offered that the annual PCB export from July 2000 to July 2001 was up to 106 kg (233 pounds) and that the rate of decline approximates a half-life of 9 years. If this rate of decline is accepted and applied to the next 20 years, it would mean that active remediation would result in almost 30 percent less PCBs resuspended and transported to Green Bay than would taking no action.

Because of technical advancements, numerous improvements have been made to dredging technologies. Results discussed in the *Sediment Technologies Memorandum* (Appendix B of the FS) indicate that dredging can be effectively implemented if the technology is designed and managed appropriately for Site conditions. Numerous improvements made to mechanical dredges (clamshell buckets) limit the release of excavated sediments, thereby minimizing sediment resuspension. Recent advances in dredge head construction and positioning technology enable accurate removal of sediment layers with minimal incidental overdredging to achieve target goals. As an example, for seven projects where overdredge was designed into the project plans, target goals were met in five cases. Hydraulic dredging can also be effectively used to control sediment resuspension. Because of unique characteristics presented by the River (bathymetry) and community (upland space for staging and processing areas), the Agencies are allowing flexibility in the implementation of dredging so that the contractor can implement the

most efficient and cost-effective technology. Since both hydraulic and mechanical dredging technologies have been demonstrated to provide a protective and environmentally beneficial result (FS, Appendix B), either technology is appropriate for the removal of PCB-contaminated sediments from the Lower Fox River. In addition, the *Sediment Technologies Memorandum* provided a comprehensive evaluation of dredging projects and concluded that dredging has been successfully implemented at various sites and that considerable experience has been gained in dredging performed around the world over the last 100 years.

As stated in the FS, 17 of the 20 projects cited in Appendix B of the FS met short-term target goals that include sediment excavation to chemical concentration, mass, horizon, elevation, or depth compliance criteria. One such project, the 2000 SMU 56/57 project, demonstrated that surface concentrations similar to those assumed by the Agencies in the RI and FS can indeed be achieved. Please also see Master Comments 5.3 through 5.5 in the RS for OUs 1 and 2.

Master Comment 5.73

Commenters stated that to achieve the RAOs and minimize the potential for contaminant releases, dredging should be restricted to otherwise scheduled navigational dredging in portions of OU 4 near the mouth of the Lower Fox River and OU 5.

Response

The Agencies addressed many sediment resuspension issues in Master Comments found throughout Section 5 of the RS for OUs 1 and 2. In response to this specific comment: The WDNR and EPA chose a remedial approach based on risk reduction. To achieve this goal will require dredging of the River in areas adjacent to the navigation channel. Dredging within the navigation channel will be negligible considering previous dredging operations conducted by the USACE.

Resuspension of PCBs does occur during navigational dredging. The WDNR and EPA disagree with the commenters that current navigational dredging would be more effective at achieving RAOs than the environmental dredging identified in the ROD for OUs 3, 4, and 5. The position of the Agencies is based, in part, on the following considerations:

1) The FRG commented (page 227, Volume 1 of FRG comments) that "…clamshell may spill 20 to 30 percent of sediment during hoisting (NAS Report, p. 199–201)."

2) Navigational dredging in the Lower Fox River is currently performed mechanically using clamshells.

3) Documented losses from the SMU 56/57 project, which used hydraulic dredging, were only an estimated 2.2 percent of the PCB mass removed.

Master Comment 5.74

Commenters stated that the remedy in the Proposed Plan does not offer any significant benefit over natural attenuation for OUs 3, 4, and 5. Commenters stated that, in fact, the proposed remedy actually hinders the natural attenuation of Green Bay by causing more PCBs (beyond what would be expected under natural attenuation) to be exported to Green Bay. Commenters believe that such increased export would result in an increase in PCB concentrations in fish in Green Bay.

Response

The WDNR and EPA disagree with several elements of the commenters' statement. Analyses provided in the RI/FS, the BLRA, and the Proposed Plan all point to significant benefits for all Operable Units from active remediation. The independent API Panel also indicated that active remediation is needed in the Lower Fox River and will assist in the remediation of the Bay. The WDNR and EPA believe that the selected remedy will, in the long run, result in reductions in PCB concentrations in the water column and in the export of PCBs into Green Bay.

In addition, there is no evidence to support the proposition that natural attenuation is occurring within OU 3 and OU 4 sediments. The Site-specific Time Trends Analysis (TTA) conducted as part of the RI shows that while the estimated annual compound percent increase in PCB levels calculated for each deposit generally declines, in many cases the upper bound of the 95 percent confidence interval shows that concentrations could be stable or increasing. In addition, the commenters' supposition that natural attenuation is occurring assumes burial of contaminated sediments in perpetuity, which is untrue. The stability of PCBs currently buried in the sediment cannot be assured indefinitely. Sediment conditions in OU 3 depend on indefinite maintenance of the current dam and lock system. At OU 4, changes in lake levels may result in increased scour to sediments (LTI, 2002). Elevations in Lake Michigan are expected to be lower through this century as a result of changes to global climate (EPA, 2000). These conditions will result in an increase in PCB load to Green Bay.

Further, the TTA did point to a stabilization, or "breakpoint," in PCB concentrations for fish in Green Bay Zone 2. While there were steep declines in fish tissue PCB concentrations from the 1970s, significant breakpoints in declines for some species begin around 1980. A meta-analysis of the most recent time trends carried out for three reaches yielded 5 to 7 percent rates of decline per year averaged across species. Six species showed an increasing rate in their final slope, but only two of those rates were statistically significant. The existence of breakpoints and an additional analysis showing non-constant rates suggest that rates of change are not stable and could be different in the future. The TTA further points out that this observation is consistent across several different fish species throughout the Great Lakes.

Finally, the commenters did not provide a quantitative assessment showing that losses from the proposed remedy would be greater than losses from natural attenuation. For that reason, the details of the comment are insufficient to allow a direct response. However, an analysis provided by one of the commenters suggests that the total mass of PCBs lost under the natural attenuation option would exceed losses from removal (see the response to Master Comment 5.4 in the RS for OUs 1 and 2). Results of dredging at SMU 56/57, which the commenter acknowledged represents the most comprehensive data set available, indicate that PCB losses approximated 2.2 percent of the mass removed.

Even if loss rates from the most highly contaminated site on the River (i.e., SMU 56/57) are applied to the entire Lower Fox River, the proposed remediation would equate to a loss of 644 kg (1,420 pounds) of PCBs. On the other hand, the commenters offered that the annual PCB export from July 2000 to July 2001 was up to 106 kg (233 pounds) and that the rate of decline approximates a half-life of 9 years. If this rate of decline is accepted and applied to the next 20 years, it would mean that active remediation would result in almost 30 percent less PCBs resuspended and transported to Green Bay than would taking no action.

The Agencies believe that the analyses conducted for the RI/FS show that active remediation in OUs 3 and 4 offers significant benefits over natural attenuation, including the return of PCB levels in Green Bay to acceptable levels within a shorter time, leading in turn to greater protection of fish and other aquatic life in the Bay. The WDNR and EPA believe the selected remedy will, in the long run, result in reduced export of PCBs to Green Bay and lower PCB levels in fish tissue.

References

EPA, 2000. *Preparing for a Changing Climate: The Potential Consequences of Climate Variability and Change, Great Lakes – A Summary by the Great Lakes Regional Assessment Group for the U.S. Global Change Research Program*. United States Environmental Protection Agency, Office of Research and Development, Global Research Program. October.

LTI, 2002. *Measurement of Burial Rates and Mixing Depths Using High Resolution Radioisotope Cores in the Lower Fox River*. In: *Comments of the Fox River Group on the Wisconsin Department of Natural Resources' Draft Remedial Investigation, Draft Feasibility Study, Baseline Human Health and Ecological Risk Assessment, and Proposed Remedial Action Plan, Appendix 10*. Prepared by Limno-Tech, Inc., Ann Arbor, Michigan.

5.2 *In-Situ* Sediment Caps

Master Comment 5.75

Commenters expressed concerns about who retains the liability risk for a capping project if the integrity of the cap is compromised in the future.

Response

As discussed in *White Paper No. 6B – In-Situ Capping as a Remedy Component for the Lower Fox River* (included in the RS for OUs 1 and 2), fiduciary responsibilities for an *in-situ* cap are equivalent to those associated with any upland landfill or soil cap. Therefore, the Responsible Parties (RPs) retain long-term liability for maintaining the cap in perpetuity, which is also consistent with soil caps at brownfield sites when there is no transfer of liability for the site. The RPs also retain liability for any damages caused or additional cleanup needed if contaminants remaining beneath the cap are released in the future.

An additional fiduciary responsibility that will need to be considered for an *in-situ* cap at the Lower Fox River involves long-term monitoring and maintenance of the cap, as well as of dams on the River, and/or the potential for management of remnant deposits in the event of dam failure or removal. However, there are no specific state-mandated long-term financial proof mechanisms for coverings placed in waterways as there are for upland disposal facilities. Any negotiated settlement with the RPs in which *in-situ* capping is implemented should contain these fiduciary provisions and a limited release from liability.

Master Comment 5.76

Several commenters argued that an engineered cap less extensive than the single option considered in the FS should have been evaluated. They further stated that the draft FS rules out thin-layer capping as an option on the grounds that River velocities are too high, despite Lower Fox River stream velocity data presented in the draft FS itself showing that even 100-year flows in OUs 1 and 3 are within the range of USACE guidance for thin-layer capping.

Response

There appears to be some confusion over what sediment capping engineers mean by the term "thin-layer" cap and what the commenters are suggesting here. As discussed in the FS, thin-layer capping involves the placement of a thin (1- to 3-inch) layer of clean sediments; that layer is subsequently mixed with the underlying contaminated sediments to achieve acceptable concentrations of chemicals of concern and/or to enhance the natural attenuation process. The mixing results naturally from the activity (bioturbation) of benthic organisms. This approach is best suited to situations involving contaminants that naturally attenuate over time or in which contaminant concentrations are sufficiently low that "dilution" is the preferred alternative; examples include the West Eagle Harbor OU in Washington state and the Ward Cove, Alaska, Superfund site (see *White Paper No. 6B – In-Situ Capping as a Remedy Component for the Lower Fox River* for a discussion). Thin-layer capping, in this sense, has not been considered an acceptable alternative for the Lower Fox River, although the FS does discuss thin-layer capping.

As discussed in the response to Master Comment 5.14 in the RS for OUs 1 and 2, the cap design thickness used in each area will be a site-specific engineering determination made during the remedial design phase.

5.3 Monitored Natural Recovery

Master Comment 5.77

Commenters stated that they agreed with the recommendation made in the Proposed Plan of MNR for zones 3 and 4 of Green Bay; however, they do not agree with the selection of MNR for areas of elevated PCB concentrations within Zone 2 of Green Bay.

Response

The WDNR and EPA assessed numerous technologies for remediation of the Lower Fox River and Green Bay, including no action, MNR, capping in combination with other technologies, dredging, and numerous disposal and treatment options. Following that assessment, the WDNR and EPA considered the effectiveness of the technologies at reducing risk at various action levels, as well as their cost and implementability.

This comment, along with other concerns raised about Green Bay, led the Agencies to address concerns about the relative lack of PCB sediment data for southern Green Bay by collecting additional data. The Agencies also reevaluated the data and methods used in Technical Memorandum 2f to estimate PCB mass and contaminated sediment volume in Green Bay. *White Paper No. 18 – Evaluation of an Alternative Approach of Calculating Mass, Sediment Volume, and Surface Concentrations in Operable Unit 5, Green Bay* evaluates a set of different factors on the estimation of concentration distribution, mass, and volume of PCBs in Green Bay. The data collected from southern Green Bay in July 2002 was used to further refine Green Bay PCB mass and contaminated sediment volumes using the alternative approach described in White Paper No. 18; this undertaking is discussed in *White Paper No. 19 – Estimates of PCB Mass, Sediment Volume, and Surface Sediment Concentrations in Operable Unit 5, Green Bay Using an Alternative Approach*.

The ROD for OUs 3, 4, and 5 states that remediation will extend a short distance into Zone 2 of Green Bay to address an area of contaminated material adjacent to the mouth of the River. Further discussion on the remedy selection for OU 5 (zones 2 through 4 of Green Bay) can be found in Section 11.3 of the ROD for OUs 3, 4, and 5.

The proposed remediation of the Lower Fox River is expected to reduce future PCB loadings to Green Bay by 98 percent. The WDNR and EPA believe that, given the limited risk reduction and substantial costs and difficulties associated with implementing an active remedial solution in Green Bay, MNR combined with the reduction of PCB loadings from the Lower Fox River is the most feasible option for zones 2, 3, and 4 of Green Bay. However, acknowledging the substantial interest by the Lower Fox River and Green Bay communities, the Agencies are proceeding with further remedial evaluations of Green Bay, including conducting the GBTOXe and GBFood models using the lower mass and volume estimates derived from White Paper No. 19. Once this work is completed, the Agencies will make the results public.

Master Comment 5.78

Commenters suggested that MNR for the downstream portion of OU 4 would satisfy remedy selection and be more implementable. They suggested that dredging in OU 4B will not start until at least 15 years from now and that natural attenuation in the downstream portions of OU 4 will continue during the time required for any active remediation in the upstream portion. A commenter stated that within 17 years, the SWAC will be less than 1 mg/kg PCBs throughout the downstream portion of OU 4 and currently buried masses will be even more deeply buried.

Response

First, the Agencies do not agree with the underlying proposition that OU 4 should be divided into two segments. Please see the response to Master Comment 2.29 for a discussion of the Agencies' reasoning.

Second, there is no basis within the FS to support the comment. The Agencies expect that remediation of OUs 3 and 4 will take place simultaneously and be completed in less than 10 years, not 17 years as assumed in the comment. In addition, the cleanup level for OU 4 is not 1 ppm SWAC; the cleanup level is the removal of all contaminated sediment above 1 ppm, which will result in a SWAC of considerably less than 1 ppm. If all the contaminated sediment above the 1 ppm RAL is remediated, the SWAC is estimated to be 0.16 ppm for OU 4. Dredging to achieve a 1 ppm RAL is the appropriate remedy for OU 4. Once dredging has been completed, the natural processes of dispersion and burial may further assist the River in its recovery.

Third, given the significant changes in sediment bed elevations documented in Technical Memorandum 2g and *White Paper No. 3 – Fox River Bathymetric Survey Analysis*, the Agencies do not agree with the commenters' conclusion that the downstream portion of OU 4 will undergo only deposition of material, in perpetuity. The Agencies' selection of the MNR alternative for OU 5 is premised on a reduction of PCB loadings to Green Bay through remediation of Lower Fox River sediments. Leaving significant deposits of PCBs vulnerable to resuspension through natural (scour) or artificial forces (ship traffic) would require reconsideration of the remedial decision for OU 5.

Master Comment 5.79

Commenters expressed opposition to the proposed selection of the MNR alternative for Green Bay. Commenters stated that MNR in Green Bay does not reduce the risks as effectively as mass removal, is not adequately protective to the public and the environment, and represents the highest risk to human health and ecology.

Response

There are significant technical and practical concerns associated with implementing any remedial action alternative in Green Bay. There are also significant costs associated with dredging in the Bay. As presented in the FS (Section 8), to obtain any measurable risk reduction would require remediating the entirety of Green Bay. None of the RALs modeled would provide 100 percent protection immediately after remediation (or after initiation of MNR) for all of the human or ecological receptors in the Lower Fox River or Green Bay. In fact, none of the RALs modeled would achieve human health RAOs in Green Bay for more than 100 years after remediation (see Table 8-15 in the FS). Projections of the level of estimated risk reduction and the time it takes to achieve that risk reduction can be used as metrics for comparing the efficacy of the RALs in each River reach and Bay zone.

Remedial modeling forecasts (FS, Section 8) showed that remediating as much as 90 million cy of sediment in OU 5 would achieve only limited reductions in risk to human health and the environment. Therefore, the Agencies do not see a risk-reduction benefit commensurate with the cost. The WDNR and EPA believe that, given the limited risk reduction and the substantial costs and difficulties associated with an active remedial solution, MNR is the only feasible option for Green Bay. In addition, the proposed remediation of the Lower Fox River is expected to reduce future PCB loadings to Green Bay by 98 percent, which will be more cost-effective at reducing long-term risks in the Bay than would active remediation in any portion of the Bay.

The WDNR and EPA realize, however, that there will be continued risk in Green Bay with the selection of MNR. Because of that continued risk, institutional controls over fish consumption will remain in place for the foreseeable future. The Agencies are also going to proceed with further remedial evaluations on Green Bay, including conducting the GBTOXe and GBFood models using lower mass and volume estimates.

Master Comment 5.80

Commenters noted that better documentation of the distribution of sediment PCBs in Green Bay south of Long Tail Point and Point Sable is needed so that the feasibility and cost of remedial actions can be further considered for at least that area of the Bay.

Response

In general, the Agencies agree with the comment. However, the Agencies believe that MNR is still the appropriate remedy for Green Bay based on the

current data. As discussed in Master Comment 2.38, one of the differences between PCB mass estimates made by University of Wisconsin researchers and those made by the WDNR is that the inner Bay, south of Long Tail Point, was not included in the University of Wisconsin's estimate because of a lack of synoptically collected sediment total PCB and bulk density measurements. In response to this and other comments about Green Bay, the Agencies decided to reexamine mass and volume estimates in Green Bay, and in particular southern Green Bay. Additional sampling was conducted in the southern Bay in July 2002, and two white papers were prepared: *White Paper No. 18 – Evaluation of an Alternative Approach of Calculating Mass, Sediment Volume, and Surface Concentrations in Operable Unit 5, Green Bay* and *White Paper No. 19 – Estimates of PCB Mass, Sediment Volume, and Surface Sediment Concentrations in Operable Unit 5, Green Bay Using an Alternative Approach*.

White Paper No. 18 compares the mass and volume estimates computed for the 2002 RI/FS with those computed in 1989 to 1990 by the University of Wisconsin during the Green Bay Mass Balance Study. Additional data sent to the Agencies as part of the comments received on the Proposed Plan by the FRG were included in that analysis.

The Agencies determined that even with the additional 2001 data in southern Green Bay, further resolution was required to: (1) better define the mass and volume estimates in Green Bay, and (2) determine if previous dredged material disposal areas used for maintenance dredging contained elevated levels of PCBs. To these ends, the Agencies coordinated further sediment sampling in southern Green Bay during the summer of 2002. The results of that sampling effort may be found on the WDNR website (http://www.dnr.state.wi.us/org/water/wm/lowerfox/reports.html) in a report entitled *Green Bay Sediment Results from July 2002 Survey, Green Bay, Wisconsin* (RETEC, 2002). A total of 99 samples were collected at 36 core locations. PCB concentrations ranged from non-detectable to 30 mg/kg (i.e., 30 ppm). High concentrations detected at Station GB02-33 reconfirmed concentrations determined for this location in 1995; those concentrations are associated with sediments adjacent to the navigation channel at the River mouth, not in Green Bay proper. Surface concentrations found in Green Bay samples (all stations except GB02-33) were less than 0.3 ppm (i.e., less than 300 micrograms per kilogram [µg/kg], equivalent to ppb) excepting subsurface concentrations at a single location (GB02-34), which were only as high as 1.4 ppm (1,400 ppb).

White Paper No. 19 documents revised PCB mass, volume, and SWACs for Green Bay, which were recalculated using the methods described in White Paper No. 18 and incorporating the 2002 data set. The conclusion of White Paper No. 19 was that even with the inclusion of the 2002 data, there are no

major differences in mass, volume, or surface concentrations from those reported in White Paper No. 18.

The end result of this work on the Bay is twofold. First, the Agencies believe the work is adequate for decision-making purposes and, therefore, the Agencies are proceeding with selection of the remedy for OU 5, which is MNR. The MNR alternative relies on naturally occurring degradation, dispersion, and burial processes to reduce the toxicity, mobility, and volume of contaminants. In selecting MNR for the Bay, the Agencies considered Superfund guidance on the nine evaluation criteria for determining whether remediation is necessary or not.

Second, the Agencies plan to conduct further remedial evaluations for Green Bay, including use of the GBTOXe and GBFood models with the lower mass and volume estimates from White Paper No. 19. Once these evaluations are complete, the Agencies will make the results public. If the Agencies find there is reason to reconsider the MNR alternative for Green Bay, they will issue a ROD Amendment consistent with requirements of the NCP.

Reference

RETEC, 2002. *Green Bay Sediment Results from July 2002 Survey, Green Bay, Wisconsin*. Prepared for Wisconsin Department of Natural Resources by The RETEC Group, Inc., Madison, Wisconsin. December. Available at Wisconsin Department of Natural Resources website: http://www.dnr.state.wi.us/org/water/wm/lowerfox/reports.html.

5.4 Remedy Selection

Master Comment 5.81

A commenter stated that the FS and Proposed Plan largely failed to present and analyze combinations of alternatives.

Response

The WDNR and EPA disagree with this comment. The FS clearly evaluated numerous technologies and combinations of technologies for identification of remedial alternatives. These technology evaluations and remedial alternative assessments were conducted on an OU basis for each OU. This evaluation appears in Sections 6 and 7 of the FS and is further discussed in the Proposed Plan. The following table summarizes the combinations of alternatives considered in the FS for each OU. The approach used for this assessment was

consistent with Superfund guidance for conducting feasibility studies (EPA, 1988).

Alternative	OU 3	OU 4	OU 5-Zone 2	OU 5-Zone 3A	OU 5-Zone 3B	OU 5-Zone 4
A	X	X	X	X	X	X
B	X	X	X	X	X	X
C1	X	X	X	X		
C2A	X	X	X	X		
C2B	X	X	X	X		
C3	X	X	X	X		
D	X	X	X	X	X	
E	X	X				
F	X	X				
G			X	X	X	

Notes:

A No Action
B Monitored Natural Recovery and Institutional Controls
C Dredge and Off-site Disposal (Alternatives C1, C2, C3)
C1 C with Passive Dewatering
C2 C with Mechanical Dewatering
C2A C2 with Hydraulic Dredging (with a long slurry pipeline to a dedicated NR 500 monofill for slurry)
C2B C2 with Intermediate Passive Dewatering Pond (prior to disposal at an existing NR 500 commercial disposal facility)
C3 Hydraulic Dredging, Mechanical Dewatering, and Ground Transportation to a Commercial Landfill
D Dredge to a Confined Disposal Facility (CDF)
E Dredge and Thermal Treatment
F *In-Situ* Capping
G Dredge to a Confined Aquatic Disposal (CAD) Facility

This table illustrates that combinations of alternatives were evaluated. For instance, Alternative F in the FS (Cap Sediment to Maximum Extent Possible and Dredge Remaining Sediment to CDF) is typically a combination of both capping and dredging. Given the criteria in the FS for placement of a cap and the need for active remediation to reduce risk, F is not an alternative that relies solely on capping. Also, as discussed in Section 8 of the FS, these combinations of alternatives were evaluated at numerous RALs, and each alternative included an additional period for the alternative to achieve all RAOs.

Reference

EPA, 1988. *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA*. Interim Final. EPA/540/G-89/004. United States Environmental Protection Agency.

Master Comment 5.82

Commenters stated that when evaluating risk and remedial approaches, the Agencies should consider that navigational dredging continues to manage contaminated sediments deposited in the downstream portion of OU 4 from upstream.

Response

The Agencies considered the following when evaluating the combination of navigational dredging and MNR as a remedial approach:

- Navigational dredging will not sufficiently reduce the contamination from the soft sediment mass that is adjacent to the navigational channel. Areas in downstream OU 4 contain significant PCB mass outside of the navigational channel. On average, the USACE dredges at rates of approximately only 103,750 cy per year from the De Pere to Green Bay Reach and 1,275 cy per year from areas of the Lower Fox River above the De Pere dam. The navigational dredging is limited to the federally authorized areas of the channel. However, most of the material targeted for remediation is located outside of the navigational channel and, consequently, is not impacted by the USACE's navigational dredging.

- In OU 4, natural attenuation would require, at a minimum, 100 years to achieve the level of action for human health risks achieved in 20 years by active remediation (FS, Figure 10-2 for 1 ppm removal).

- PCB concentrations greater than 1 ppm are an unacceptable risk to human and ecological health, and the current risk is unacceptable to both the EPA and WDNR.

- The stability of PCBs currently buried in sediment cannot be assured indefinitely. Active remediation is a more effective measure for protecting human health and will more quickly reduce the PCB export into Green Bay.

- Bathymetry data indicate that resuspension will lead to reexposure of contaminants, for which natural attenuation does not provide an acceptable level of protection.

- The sediments of the Lower Fox River are not a secure location for the long-term storage of PCBs.

- Analyses in the RI/FS, BLRA, and Proposed Plan all point to significant benefits from active remediation in OU 4, including the

achievement of acceptable PCB levels within a shorter time, reduced water column concentrations, reduced human and ecological risks, and an increased level of protection.

- The API Panel of independent experts agrees that active remediation is needed in the Lower Fox River.

- Active remediation will immediately reduce sediment loading (loading from the Lower Fox River will be reduced by over 90 percent after active remediation).

- It has been demonstrated that environmental dredging can lower concentrations without the release of significant quantities of contaminated sediments.

Master Comment 5.83

Commenters stated that decisions for OU 3 and OU 4 must be reach-specific and must reflect input from downriver discharges. Commenters stated that the Proposed Plan did not include reach-specific analysis of alternatives.

Response

Although the WDNR and EPA agree that Site-specific analysis is very important, the Agencies disagree with this statement. The Agencies based their remedy decision on an individual assessment of the degree and extent of contamination at each OU, as detailed in the RI.

Site-specific determinations are required for Superfund sites. Site conditions and characteristics, as well as available data, are critical considerations in determining cleanup levels appropriate for each site. These considerations include impacted media and potential exposures, contaminant toxicities and concentrations, the nature of risks to human health and the environment, and the quality and type of available data. Characteristics specific to sediment sites also include horizontal and vertical contaminant distribution, sediment thickness and physical characteristics, relationships between media (i.e., sediments, groundwater, surface water, biota, air), and the potential for releases and exposures. All these are factors in determining the most effective and protective use of available information to estimate and measure potential site risks. For OU 3 and OU 4 of the Lower Fox River and Green Bay Site, an RAL defining a specific vertical and horizontal target area was determined to be the most appropriate, protective, and feasible approach for estimating and measuring Site risks.

The basis for the selection of the technology and the RAL in the remedy for the Lower Fox River is stated in the Proposed Plan. Feasibility, cost, risk, and reach-specific approaches were all considered, as discussed in the RI/FS, BLRA, and Model Documentation Report that support the Proposed Plan. These considerations are also part of the formal Superfund evaluation process (i.e., the nine "threshold, balancing, and modifying" criteria).

In developing the RI/FS, BLRA, and Proposed Plan, the WDNR followed EPA guidance and worked closely with the EPA. The FS evaluated numerous technologies and combinations of technologies for remedial purposes. These technology evaluations and assessments appear in Sections 6 and 7 of the FS and are discussed in the Proposed Plan. In the FS, predictive simulations made using computer models were successfully used to assist in the assessment of specific management scenarios and the selection of specific remedial actions and Site-specific goals for the protection of human and ecological health. The Agencies believe the remedy selected in the ROD for OUs 3, 4, and 5 will be technically feasible and cost-effective and will achieve the Site-specific RAOs.

Master Comment 5.84

Commenters expressed the opinion that OU 4 is a natural depositional zone in which cleaner sediments bury the deposited PCBs and there is little or no scouring. Further, the commenters stated that the Proposed Plan focuses on PCB mass removal rather than on minimizing exposure to PCBs. The commenters disagreed with the remedial proposal for OU 4 and expressed the opinion that dredging should be the last choice for remediation of this reach.

Response

The WDNR and EPA disagree with these statements. The Agencies believe it is incorrect to characterize OU 4 as a continuous depositional area. Further, the Proposed Plan presented by the Agencies is in fact based on risk reduction, not on PCB mass removal.

The WDNR demonstrated, in Technical Memorandum 2g in the Model Documentation Report, that the riverbed in OU 4 is dynamic in nature and can have significant changes in bed elevation throughout the OU. The EPA documented significant changes in sediment bed elevation over time in *White Paper No. 3 – Fox River Bathymetric Survey Analysis*, which is appended to the ROD for OUs 1 and 2.

In recommending and selecting the dredge alternative for OU 4, the Agencies have followed the appropriate Superfund guidance. The Superfund process focuses on protection of human health and the environment through the

cleanup and remediation of environmental hazards. By following Superfund guidance, a complete analysis of the nature and extent of the contamination was conducted. In the BLRA and FS, existing risk was evaluated, risk reduction estimates were developed, and appropriate remedial technologies and RALs were selected. In the Proposed Plan and in the ROD, the remediation is clearly set forth to inform the public.

The Proposed Plan is based on risk reduction, not mass removal, as explained in Section 9 of the Proposed Plan and further illustrated in Section 10 of the ROD for OUs 3, 4, and 5. The RAL of 1 ppm is based on risk reduction, not mass removal, as presented in Section 8 of the FS. The WDNR and EPA selected the 1 ppm RAL based on an evaluation of action levels and the residual SWAC for each OU and the ability of the action level to meet the RAOs. For further discussion, please review the supporting document that explains the relationship of the RAL to the SWAC and *White Paper No. 11 – Comparison of SQTs, RALs, RAOs, and SWACs for the Lower Fox River.*

Master Comment 5.85

Commenters stated that the cleanup should be as comprehensive and effective as possible and should include the removal of contaminated sediments from Green Bay.

Response

The Agencies believe that the remedial alternatives selected for OUs 3, 4, and 5 are comprehensive and will be effective in remediating the Lower Fox River and Green Bay to the maximum extent practicable.

To address concerns raised about Green Bay, the WDNR undertook several actions. These included reevaluating the PCB mass and contaminated sediment volume in the Bay, conducting additional sampling in the south end of the Bay, and conducting modeling to evaluate removal of contaminated sediments. These actions are discussed further in responses to Master Comments 2.37, 2.38, 2.39, 5.77, and 5.80.

5.5 Evaluation of Submitted Alternatives

Master Comment 5.86

Commenters stated that vitrification should be considered if it can be shown to be an effective and cost-effective means of totally destroying PCBs. If that is the case, then the Agencies should work with potential corporate partners to incorporate this technology into the ROD wherever practicable.

Response

The Agencies continue to work on demonstrating both the cost-effectiveness and treatment effectiveness of vitrification. Identification of the technology and vendor selection occur subsequent to the ROD, such as during the remedial design phase. In the FS, vitrification was included as a representative process option for thermal treatment in Sections 7.4 (OU 3) and 7.5 (OU 4). The results of a multiphase study conducted by the WDNR demonstrate that thermal treatment is a feasible option for the treatment of dredged sediment, as data generated by the EPA's Superfund Innovative Technology Evaluation program shows that vitrification (also referred to as glass furnace technology) does not generate dioxins and furans in the off-gases and effectively destroys PCBs at greater than 99.9999 percent efficiency. The results from the multiphase study are discussed in Section 6 of the FS and also detailed in Appendix G of the FS. Figure 7-6 of the FS provides a schematic of the generic dredge and thermal treatment remedial alternative. Vitrification was also included in the ROD for OUs 1 and 2 as an acceptable alternative to landfills. There is a discussion of vitrification in Section 13.8 of the ROD for OUs 3, 4, and 5.

Master Comment 5.87

Several commenters expressed concerns related to the Panel Report and a preference for removal rather than capping in OUs 3 and 4. As previously addressed in Section 5.5 of the RS for OUs 1 and 2, the Panel Report (The Johnson Company, 2002) was submitted as part of the comments during the public response period. The Panel Report includes a plan for long-term monitoring of cap integrity (physical, chemical) and habitat; a long-term institutional/financial stewardship plan (operations and maintenance); and an appendix with cost-supporting information for the API Panel's capping proposal, which presents different capping designs for different deposits/SMUs in OUs 1, 3, and 4; however, the API Panel's capping proposal does not cover capping in Green Bay.

Comments received from the public on the Panel Report stated:

- That the API Panel's plan ignored the high health risks and substantial PCB mass in Zone 2 of lower Green Bay when it stated that the plan would be sufficient to meet public health needs.

- That the API Panel did not consider that cap material erosion increases the clogging of downstream locks, shipping channels, and marinas, increasing maintenance problems and costs.

- That the total mass of PCBs will remain toxic; therefore, the last 3.5 River miles warrant remediation.

Response

Appleton Papers, Inc. (API) provided funding to assemble a panel of professors and scientists to evaluate the Proposed Plan. The API Panel completed a report entitled *Ecosystem-Based Rehabilitation Plan – An Integrated Plan for Habitat Enhancement and Expedited Exposure Reduction in the Lower Fox River and Green Bay* (referred to herein as the "Panel Report") dated January 17, 2002 (The Johnson Company, 2002). The Panel Report was submitted as part of the comments during the public response period for OUs 1 and 2. As part of the RS for OUs 1 and 2, a series of white papers were written specific to the Panel Report, and Section 5.5 of the RS for OUs 1 and 2 addresses comments received from the Fox River RPs and the general public on the Panel Report. Master Comments based primarily on the Panel Report are also discussed in Master Comments 5.87 thru 5.89 of this RS.

Comments about the Panel Report are not directly applicable to the Proposed Plan, RI/FS, or BLRA on which the WDNR and EPA sought public comment. Although the WDNR and EPA appreciate the input and comments from the API Panel, whose members have impressive credentials and years of experience, the Agencies regret that the API Panel was not engaged earlier in the process and was not given an opportunity to work with the WDNR and EPA prior to the release of its report. Specific issues raised in the Panel Report were addressed in the RS for OUs 1 and 2 and throughout the series of white papers developed for that RS.

Although several parties supported the API Panel's capping plan, the WDNR and EPA believe that capping could be a remedial component, but not the sole component. Furthermore, the Agencies believe that the design provided by the API Panel is not technically sound; the design is based on computer models and has never been implemented. The API Panel cannot point to a single cap with this design that has been implemented successfully in any environment, much less a river environment.

In addition to the comments on the Panel Report contained in the RS for OUs 1 and 2, the WDNR and EPA believe that some of the conclusions bear repeating in relation to OUs 3, 4, and 5. In and of itself, the API Panel proposal is considered insufficiently protective for the following reasons:

- The Panel Report proposal does not achieve the RAOs or the risk reduction goals set by the Agencies for any of the OUs. The risk reduction aspects of the Panel Report are examined in *White Paper No.*

5A – Responses to the API Panel Report, which is part of the RS for OUs 1 and 2. The SWAC achieved with the API Panel capping proposal is up to four times greater than the SWAC achieved with the remedy selected in the ROD.

- The Agencies judged the Panel Report's capping design to be technically deficient and too broadly applied. However, a summary of all capping projects to date (provided in *White Paper No. 6B – In-Situ Capping as a Remedy Component for the Lower Fox River*, which is part of the RS for OUs 1 and 2) shows that the caps built to date average within the 2- to 3-foot range of sand thickness. All of these caps are in lakes, estuaries, or deeper water not subject to erosional actions.

- The WDNR and EPA agree that risk reduction should be the ultimate goal of any sediment remediation project, whether the program involves MNR, capping, or removal. The WDNR and EPA have chosen a remedial approach based on risk reduction. Given the circumstances of the Lower Fox River, this approach also results in significant PCB mass removal in OUs 3 and 4. However, the remedy selected for OU 5 is not a mass removal activity. The selected remedy is risk-based, in that following remediation, the residual SWAC based on the RAL of 1 ppm will result in significant risk reduction.

Reference

The Johnson Company, 2002. *Ecosystem-Based Rehabilitation Plan – An Integrated Plan for Habitat Enhancement and Expedited Exposure Reduction in the Lower Fox River and Green Bay*. Prepared for the Appleton Paper, Inc. Panel by The Johnson Company, Inc. January 17.

Master Comment 5.88

Comments were received on claims made concerning the API Panel's capping plan. These claims included:

- Capping would reduce the SWACs faster than a dredging remedy would.

- The API Panel's plan would require an enormous volume of locally excavated sand and gravel to be transported and placed in the River with heavy equipment.

- The API Panel's plan would offset any River habitat enhancement.

- The API Panel's plan would reduce the future use of shallow areas.
- The API Panel's plan would clog downstream locks, shipping channels, and marinas with eroded material.
- In-water capping in OU 3 and OU 4 was not fully or fairly evaluated by the API Panel's plan.
- The long-term permanence of in-water caps was not fully considered by the API Panel's plan.

Response

The WDNR and EPA appreciate the input from the API Panel and agree with many of the API Panel's statements. The Agencies, which learned about the API Panel only after the Proposed Plan was released, regret that the API Panel was not engaged earlier in the process and was not given an opportunity to work with the WDNR and EPA prior to the release of its report. Although the Agencies agree with many statements made by the API Panel, the Agencies find that some conclusions are incorrect or reflect problematic regulatory or Site-specific knowledge. The WDNR and EPA believe that although capping is and can be an appropriate part of a remedial design, it should be a remedy component, not the sole component. Furthermore, the Agencies believe that the design provided by the API Panel is not technically sound. The WDNR considered capping in Alternative F in the FS; Table 7-2 in the FS shows that Alternative F involved capping 416,370 cy in OU 3 and 1,833,253 cy in OU 4.

The WDNR and EPA determined in their evaluation of the Panel Report that the API Panel's capping proposal does not meet the risk reduction goals of the Proposed Plan. The WDNR and EPA agree that risk reduction should be the ultimate goal of any sediment remediation project, whether the program involves MNR, capping, or removal. However, the SWAC achieved with the API Panel capping proposal is up to four times greater than the SWAC achieved with the selected remedy. Even accepting the API Panel's calculations, the estimated SWAC is 0.5 ppm on a River-wide basis. In the Proposed Plan, SWACs estimated for dredging are 0.264 and 0.156 ppm for OUs 3 and 4, respectively, which are significantly more protective. Although the Panel Report did not estimate a time frame for the removal of fish advisories after capping, such time frame would be longer than under the recommended alternative, because the API Panel proposes to leave a significantly greater amount of material untreated than in the Proposed Plan.

The WDNR agrees with the comment that the API Panel's plan does not consider the method for placing large volumes of capping material in the River. *White Paper No. 6B – In-Situ Capping as a Remedy Component for the*

Lower Fox River, which is part of the RS for OUs 1 and 2, demonstrates several representative mechanisms for cap placement. In most caps constructed to date, split-hull barges, a technology inappropriate to the Lower Fox River, have been used.

As articulated in White Paper No. 6B, the necessary minimal engineering design evaluations include:

- Modeling to assess consolidation
- An evaluation of the potential for advective and diffusive flux from either consolidation or from groundwater intrusion
- An evaluation of local capping material and iterative design testing to ensure that the cap design is effective at chemical isolation
- An evaluation of the 100-year shear-stress forces at the sediment/water interface to effectively evaluate physical stability and design an armoring layer as necessary
- An evaluation, as required by Wisconsin law, of whether cap placement would result in an alteration to the flood channel

The same principles would be applied to any cap proposal for OUs 3 and 4. What's more, these are only some of the technical considerations and do not include the regulatory, public acceptance, land use, and long-term fiduciary responsibility issues.

As a commenter noted, erosion is also a concern. Caps in lakes, estuaries, and deeper water are not subject to erosional actions; however, because of the factors that affect mass movement in the Lower Fox River, erosional actions must be taken into consideration for this Site. The API Panel's discussion of cap permanence did not consider how Lower Fox River hydraulics would be modified by the placement of a 1-foot cap in the River, which would reduce the River's cross-sectional area and therefore increase water flow velocities and potential scour. Because the API Panel's plan considered remedial activity in any area of the River with a depth of less than 3 feet, ice scour would also become a concern. Ice scour is a considerable erosional factor for caps placed in water depths of 3 feet or less. For these reasons, the WDNR concluded that the API capping plan places caps at physically inappropriate areas of OU 4. A summary of all capping projects to date (provided in White Paper No. 6B) demonstrates that the caps built to date average within the 2- to 3-foot range of sand thickness. In addition, WDNR fisheries biologists indicate that as a habitat consideration, a minimum water depth of 3 feet should be maintained to discourage carp.

The calculations for resuspension of capping materials in the Panel Report do not consider mass movement processes—that is, the movement of sediments as a slurry or by siltation processes. Such processes mean that capping material could be disrupted without necessarily being resuspended. In addition, *White Paper No. 6A – Comments on the API Panel Report* and White Paper No. 6B point out that long-term lake level changes (from +5 to -1 feet) should be accounted for in designing for the restrictions at OU 4. The potential (especially long-term potential) for erosion resulting from lower lake levels, which are anticipated in the Great Lakes because of global warming, was not considered. Lower lake levels are already occurring, and expert climatologists estimate a Lake Michigan lake level that is lower by 1.5 to 3 feet over the next three decades and lower by up to 8 feet by the end of this century (see Executive Summary and Report Cover for the Report of the Great Lakes Regional Assessment Group, U.S. Global Change Research Program, Great Lakes Overview, October 2000). The Report of the Great Lakes Regional Assessment Group also predicts the likelihood of greater variability and severity of storm (e.g., flooding) events. Given all of the data cited above, the Agencies judge the Panel Report design to be technically deficient and too broadly applied, at least across OU 4.

References

Palermo, M. R., J. E. Clausner, M. P. Rollings, G. L. Williams, T. E. Myers, T. J. Fredette, and R. E. Randall, 1998a. *Guidance for Subaqueous Dredged Material Capping*. Technical Report DOER-1. United States Army Corps of Engineers Waterways Experiment Station, Vicksburg, Mississippi. Website: http://www.wes.army.mil/el/dots/doer/pdf/trdoer1.pdf.

Palermo, M. R., J. Miller, S. Maynord, and D. Reible, 1998b. *Assessment and Remediation of Contaminated Sediments (ARCS) Program Guidance for In-Situ Subaqueous Capping of Contaminated Sediments*. EPA 905/B-96/004. Prepared for the Great Lakes National Program Office, United States Environmental Protection Agency, Chicago, Illinois. Website: http://www.epa.gov/glnpo/sediment/iscmain.

Master Comment 5.89

Comments by the API Panel and others expressed concerns with construction and operation of the proposed dredged slurry pipeline, including:

- Feasibility of the proposed slurry pipeline
- Permits for pipeline transport of sediments
- Local opposition to the pipeline
- Lack of availability of landfill location(s) to receive pipeline slurries

Response

The WDNR and EPA believe that the proposed pipeline alternative for the transport of dredged slurry, which was investigated thoroughly in the FS, is a technically feasible alternative. A project-specific example of the feasibility of this technology is the White Rock Lake sediment dredging project, described in the FS (Section 6) as a 20-mile-long pipeline project in Texas in which 3 million cy of sediment was hydraulically dredged in 1 year.

The WDNR and EPA believe that the level of detail in the Proposed Plan and FS is appropriate at this stage of the project. The FS identified potential locations for support facilities to allow an analysis of equipment requirements and the development of conceptual engineering plans and cost estimates for the remedial alternatives. Potential locations were determined based on screening-level field observations made from an engineering perspective. For final design of the process and disposal facility, additional analyses will be performed to gather more detailed information regarding slurry characteristics. The WDNR and EPA plan to utilize an experienced expert technical review team to further assess planning for, operation of, and construction of the pipeline.

The end location(s) of the pipeline will be determined during the project's design stage. The locations selected in the FS represent reasonable assumptions with regard to distance from the dredging work.

While pursuing the purchase of an abandoned railroad right-of-way for the Fox River Trail, the WDNR negotiated with the railroad for use of the trail's right-of-way to retain the option of locating a pipeline to transport dredged sediments to potential landfill sites in southern Brown County. While the specific pipeline route has yet to be chosen, it is possible that the pipeline will be a combination of in-water and out-of-water pipeline technologies and that a portion of the Fox River Trail right-of-way may be used for the pipeline. These decisions will be made during the design phase of the project. The state did negotiate use of the trail's right-of-way.

The WDNR knows of no state or federal permits that would prevent construction of a pipeline for dredge slurry transfer; however, local building permits may be necessary. Negotiations will also take place regarding public access and right-of-way, and public input may be sought prior to any pipeline construction. Information about the proposed facilities, technologies considered, and public comment/input will be considered in the final design. A dredge slurry pipeline would minimize equipment traffic in areas adjacent to the Lower Fox River.

Local landfills with sufficient capacity to receive contaminated sediment from OUs 3 and 4 exist. In fact, local landfills may be interested in contracting for

the disposal of sediments, because the sediments represent a long-term waste stream. Potential disposal locations exist in the Greenleaf and Holland town areas. Identifying actual landfills to accept the sediment will occur in the remedial design phase. Public input would be considered as part of the siting process for any disposal facility.

As documented in *White Paper No. 23 – Evaluation of Cost and Implementability of Alternative C2B for Operable Unit 3 and Operable Unit 4,* technical and cost issues associated with the possible use of a pipeline to remove dredge slurry from the River have been addressed by the WDNR. It was determined that Alternative C2B (use of a pipeline to transfer dredge slurry) is an implementable and technically feasible alternative.

6 Modeling Development and Application

Section 6 of the RS for OUs 1 and 2 included the following subsections:

- *6.1 Modeling Development and Application*
- *6.2 wLFRM*
- *6.3 FRFood*
- *6.4 FoxSim (the Fox River Group Model)*

The RS for OUs 3, 4, and 5 follows the same general organization as the RS for OUs 1 and 2. However, many of the comments addressed in the RS for OUs 1 and 2 are generally applicable to the entire Lower Fox River and Green Bay Site and so are not repeated here. Because there are no new comments associated with Sections 6.1 and 6.4, those sections are not included in the RS for OUs 3, 4, and 5. Prior comments associated with those sections can be found in the RS for OUs 1 and 2, which is available on the WDNR website, at the various information repositories, and in the Administrative Record for the Site. The WDNR's website address is: http://www.dnr.state.wi.us/org/water/wm/lowerfox/rifs/index.html.

Section 6 of the RS for OUs 1 and 2 included Master Comments 6.1 to 6.21. Master Comment 6.22 is therefore the first comment in the RS for OUs 3, 4, and 5. Comments addressing the GBTOXe model appear in Section 6.2; comments addressing the GBFood model appear in Section 6.3. The titles of those sections have been modified to reflect these additions.

6.2 wLFRM and GBTOXe

Note: Comments concerning GBTOXe are included in this section.

Master Comment 6.22

A commenter expressed concern that wLFRM contains errors that create an increase in OU 4 PCB concentrations initially, resulting in an underestimation of the degree to which natural attenuation is taking place.

Response

The WDNR addressed this issue in Section 6.2 of the RS for OUs 1 and 2. The commenter incorrectly implies that the wLFRM model, or any model, was used solely to make remedial decisions. The WDNR and EPA agree that no model can predict future conditions with a high degree of accuracy.

Models are only one component of the remedial decision-making process, and were used only to help compare relative differences between the various alternatives and action levels described in the FS. *White Paper No. 9 – Remedial Decision-Making in the Remedy Selection for the Lower Fox River/Green Bay Remedial Investigation, Feasibility Study, and Proposed Remedial Action Plan* describes how information from many different sources and supporting studies was employed to identify the need to implement an active remediation strategy for the Lower Fox River and Green Bay Site. No single source of information was relied on in remedy selection. The combined findings of numerous supporting studies provide the clear weight of evidence that supports remedy selection. This decision-making process is consistent with the nine CERCLA criteria, as discussed in Master Comment 6.3 of the RS for OUs 1 and 2. With regard to the technical concerns raised by commenters about wLFRM, these are addressed in responses to other Master Comments in Section 6.2 of the RS for OUs 1 and 2.

Master Comment 6.23

Commenters stated that areas of OU 4 where wLFRM predicts erosion are actually areas that the USACE dredges to keep the channel open for commercial traffic. They assert that the evidence of new deposits that require dredging refutes the prediction about this reach's erosional character.

Response

The WDNR and EPA disagree with this comment. The commenters are incorrect regarding the location and the extent of dredging in OU 4. The only areas where dredging has routinely occurred are the Fort James (Georgia Pacific) and East River turning basins. As documented in Technical Memorandum 2g, much of the navigation channel has not been dredged in 30 years. In the few locations where dredging has occurred, many areas have been dredged only once. In fact, in the analysis of Lower Fox River sediment data prepared by Limno-Tech (LTI, 2002), Section 2.6.3 states that by 1967 dredging was unnecessary in areas upstream of the Fort James Paper Company and had not been conducted prior to 1983. The reason dredging has not occurred in much of the navigation channel is that sediment bed elevations have either been relatively constant or have decreased over time.

Monitoring of OU 4 indicates that it is both erosional and depositional over time. Technical Memorandum 2g documents sediment bed elevation changes in the River, including OU 4, using River hydrographic surveys from 1977 to 1998. Average bed elevation changes over time for the selected long-term (USACE) cross-channel range lines ranged from –5.5 to +5.4 centimeters per year (see Table 7 of Technical Memorandum 2g). These results document the

dramatic changes in sediment bed elevations that can occur as the bed of the Lower Fox River is continuously reshaped by the wide range of flows and loads the River experiences.

Bed elevation changes in the De Pere to Fort James reach were further examined through recent hydrographic surveys completed by the USACE. Data for the 1997, 1998, and 1999 surveys were available in a form that permitted calculation of bed elevation changes for all locations. The De Pere to Fort James (Georgia Pacific) channel has not been dredged since the 1960s, so changes in bed elevation reflect the natural channel-forming dynamics of the River. This pattern is also documented by bed elevation data collected by the USACE. These profiles show that large changes in sediment bed elevation can occur. Additionally, a recent study also suggests that portions of the sediment bed downstream of the De Pere dam may be subjected to increased erosion (observed as decreased sediment bed elevations) in response to declining water levels in Green Bay/Lake Michigan. As a side note, the accuracy of the USACE hydrographic surveys was confirmed by field tests at SMU 56/57 in August 1999; it was determined that the combined vertical accuracy achieved by the USACE Kewaunee Office was approximately ±4 cm.

Please also see *White Paper No. 3 – Fox River Bathymetric Survey Analysis* and the responses to Master Comments 6.2 and 6.7 in the RS for OUs 1 and 2.

Reference

LTI, 2002. *Measurement of Burial Rates and Mixing Depths Using High Resolution Radioisotope Cores in the Lower Fox River*. In: *Comments of the Fox River Group on the Wisconsin Department of Natural Resources' Draft Remedial Investigation, Draft Feasibility Study, Baseline Human Health and Ecological Risk Assessment, and Proposed Remedial Action Plan, Appendix 10*. Prepared by Limno-Tech, Inc., Ann Arbor, Michigan.

Master Comment 6.24

Several commenters stated that computer modeling supporting the RI/FS and Proposed Plan's analysis is flawed. Specifically, these commenters argued that the GBTOXe model: (1) relies on a "flawed" prediction of loadings to Green Bay because of its dependence on the wLFRM model, and (2) relies on an inaccurate description of mass in the Green Bay bed maps. Identifying these issues as "fundamental flaws," commenters argue that the GBTOXe cannot accurately predict future conditions and should not be used to make remedial decisions.

Response

Regarding the commenters' first point, that the GBTOXe model relies on the wLFRM model, which is "flawed:" The WDNR and EPA believe that the GBTOXe, coupled with wLFRM and the Green Bay bed maps, provides an appropriate transport model evaluation for use in conjunction with the other tools cited in the response to Master Comment 6.3 in the RS for OUs 1 and 2. The models used in the RI/FS were developed over multiple years in a collaborative process that involved scientists and mathematicians from the Agencies as well as scientists in the public sector and with the FRG. The model process was reviewed thoroughly and broadly. This review included input from the USGS, USFWS, USACE, and researchers and scientists from the University of Wisconsin, University of Connecticut, and Manhattan College. The models were peer-reviewed by a panel assembled by the EPA, as well as by an independent panel assembled by the American Geological Institute.

The position of the Agencies is that the wLFRM accurately represents the critical features of Lower Fox River Site conditions. The Agencies previously responded to critiques of the wLFRM in Section 6.2 of the RS for OUs 1 and 2 and in *White Paper No. 16 – wLFRM Development and Calibration for the Lower Fox River/Green Bay Remedial Investigation, Feasibility Study, Proposed Remedial Action Plan, and Record of Decision*. Those documents note that the wLFRM is the product of more than 10 years of field study and four generations of model development and performance assessment, including the direct, collaborative involvement of the FRG and consultants through their participation in the Model Evaluation Workgroup (Workgroup). The development histories of the model framework, IPX 2.7.4, and its application to the Lower Fox River have been extensively documented through numerous reports and peer-reviewed journal publications, and development of the wLFRM is consistent with information put forward by the Workgroup in a series of technical memoranda (included in the Model Documentation Report). Alternative models proposed by the commenters have not been subjected to the same level of scrutiny and thus are not adequate for use in lieu of wLFRM. These arguments are presented in *White Paper No. 15 – FoxSim Model Documentation*.

Regarding the commenters' second point, that the GBTOXe model relies on an inaccurate description of mass in the Green Bay bed maps: PCB concentrations assigned as initial conditions in the sediment segments of GBTOXe are based on information contained in the sediment bed maps; differences in mass do not equate to differences in predictions in transport and bioaccumulation. Mass estimate differences in the PCB bed maps are presented and discussed in *White Paper No. 18 – Evaluation of an Alternative Approach of Calculating Mass, Sediment Volume, and Surface Concentrations*

in Operable Unit 5, Green Bay. The white paper looks at the potential differences in mass estimates derived using the approach outlined in Technical Memorandum 2f or the approach taken by the University of Wisconsin researchers (Manchester et al., 1996). As presented in both Technical Memorandum 2f and the University of Wisconsin method, it is possible to develop a variety of PCB mass estimates for Green Bay based solely on the magnitude of the factors influencing PCB mass. White Paper No. 18 concludes that the factors influencing mass estimates are: (1) the depth to which PCBs are thought to exist, and (2) decisions about which data are/are not included in the mass estimates. An evaluation following University of Wisconsin procedures provides a sound estimate of PCB mass in Green Bay. *An equally important conclusion is that regardless of the method used, the PCB surface concentrations for the zones in Green Bay are similar.*

Surface sediment concentration, not mass, contributes to model projections made using GBTOXe. The commenters incorrectly imply that differences in mass would lead to different conclusions about sediment, water column, and ultimately fish tissue concentrations over time. However, differences in the concentrations in the upper layers of the sediment would have more of an effect on exposure concentrations for benthic and pelagic organisms, while differences in PCB mass (made using different estimates of the extent of contamination at depth) would have less of an effect on tissue concentrations in benthic and pelagic organisms. As noted above, differences in mass estimates are largely attributable to how deep the PCBs are assumed to be in the sediment column; differences in surface concentrations between the two methods are negligible.

One additional important insight provided by the enhanced PCB fate calculations is that the rate of decline in water column PCB concentrations in Green Bay is slower than predicted in previous estimates. Computations made with GBHYDRO, a fine-grid hydrodynamic model, indicate that estimates of flushing times computed by GBTOXe were exaggerated because of numerical mixing resulting from the coarse segmentation. Lower PCB concentrations in the surface sediment layer would reduce computed water column PCB concentrations; however, the rate of decline in these concentrations would be relatively slow.

Reference

Manchester-Neesvig, Jon B., Anders W. Andren, and David N. Edgington, 1996. Patterns of mass sedimentation and deposition of sediment contaminated by PCBs in Green Bay. *Journal of Great Lakes Research*. 22(2):444–462.

Master Comment 6.25

Some commenters stated that GBTOXe cannot accurately predict future conditions in Green Bay because: (1) a subroutine "used in the model to predict sediment resuspension was discarded because it predicted PCB concentrations in the water column an order of magnitude above those measured," and (2) the available calibration data (for a 17-month period) is inadequate for a 100-year projection.

Response

The WDNR and EPA believe that both statements are inaccurate. Regarding the commenters' first point, that a subroutine used in the model to predict sediment resuspension was discarded: GBTOXe results from an effort to enhance and reevaluate the previous Green Bay PCB fate model, GBTOX, which was developed by Bierman et al. (1992) and updated by De Pinto et al. (1993). The process for evaluating the models used in the Lower Fox River and Green Bay RI, BLRA, and FS was established through an agreement between the WDNR and the FRG in January 1997. Enhancements were made to GBTOX as part of this project, resulting in the model referred to as GBTOXe. The enhancements included development of a new model segmentation, incorporation of water column circulation and mixing processes from a high-resolution hydrodynamic model (GBHYDRO), and incorporation of sediment resuspension and sediment solids flux rates from a high-resolution sediment transport model (GBSED).

Water column circulation included in GBTOXe is based on results from GBHYDRO, a high-resolution, three-dimensional hydrodynamic model (HydroQual, 1999) that contains over 10,000 water column segments. Analyses conducted during the development of GBHYDRO indicated that transport described in the 12 water column segments of GBTOX underestimated the residence time in Green Bay. Computational resource constraints associated with 100-year contaminant fate projection analyses necessitated an aggregation of the GBHYDRO grid, resulting in a GBTOXe segmentation that contains 1,490 water column segments. Hydrodynamic information from GBHYDRO was aggregated onto the GBTOXe grid. This represents a substantial improvement of the description of the transport in this large body of water.

A sediment transport model, GBSED, coupled to GBHYDRO, was developed (HydroQual, 1999) and used to calculate the transport of cohesive solids in Green Bay. GBSED results indicate that wind-driven waves are the dominant factor affecting resuspension of PCB-contaminated sediments in Green Bay, particularly in the shallow portions of the lower Bay near the mouth of the Lower Fox River. Incorporation of the results of this more detailed approach

to solids transport represents an important refinement to the process of evaluating the fate of PCBs in Green Bay. The comment that "one of the subroutines used in the model to predict sediment resuspension was discarded because it produced PCB concentrations in the water column an order of magnitude above those measured" is not true. The decision to develop and use the results of a more detailed sediment transport model was made and implemented on technical merits before GBTOXe development was initiated.

Regarding the commenters' second point, that the available calibration data are inadequate to support a 100-year projection: GBTOXe was calibrated for a 17-month period from January 1989 through May 1990 using data from the GBMBS, as was done in the calibration of GBTOX (De Pinto et al., 1993). An ideal PCB calibration data set would include sediment data from at least two comprehensive monitoring programs separated in time by roughly 10 years, as well as detailed spatial and temporal water column measurements collected throughout the interval between the sediment sampling. A data set of this type is not common nor was one available for Green Bay. The 17-month period used for calibration represents the most data-rich period available.

References

Bierman, V. J., J. V. De Pinto, T. C. Young, P. W. Rodgers, S. C. Martin, R. Raghunathan, and S. C. Hintz, 1992. *Development and Validation of an Integrated Exposure Model for Toxic Chemicals in Green Bay, Lake Michigan*. Prepared for United States Environmental Protection Agency, Large Lakes and Rivers Research Branch, Environmental Research Laboratory, Duluth, Michigan. September 1.

De Pinto, J. V., V. J. Bierman, and T. C. Young, 1993. *Recalibration of GBTOX: An Integrated Exposure Model for Toxic Chemicals in Green Bay, Lake Michigan*. Prepared for United States Environmental Protection Agency, Large Lakes and Rivers Research Branch, Environmental Research Laboratory, Grosse Ile, Michigan. December 31.

HydroQual, 1999. *Hydrodynamics, Sediment Transport and Sorbent Dynamics in Green Bay*. HydroQual, Inc., Mahwah, New Jersey. March.

Master Comment 6.26

Commenters stated that wLFRM treats SMUs in the center of the channel of OU 4 as erosional, when the River is depositional. The commenters further assert that this error does not exist in the FRG's alternative FoxSim model.

Response

This comment contains two separate elements. On the basis of extensive investigation, it is the Agencies' position that:

- The SMUs in the central channel of OU 4 are both erosional and depositional, as is the River.

- wLFRM is the most appropriate model for predicting the fate and transport of PCBs in the River and Bay.

Regarding the commenters' first point, that the River is depositional: The Agencies contend that OU 4 SMUs contain both erosional and depositional environments. The evidence to support this position is presented in the Agencies' response to Master Comment 6.23, which also references Technical Memorandum 2g. Technical Memorandum 2g, which examined sediment bed elevation changes in the River, documents that dramatic changes in sediment bed elevations can occur as the bed of the Lower Fox River is continuously reshaped by the wide range of flows and loads the River experiences.

On the basis of results from the 1997 to 1999 USACE hydrographic surveys of the River navigation channel between the De Pere and Fort James (Georgia Pacific) turning basins, the average sediment bed elevation change over a specific time period was used to estimate a net rate of sediment accumulation. As discussed in Section 2.3 of *White Paper No. 16 – wLFRM Development and Calibration for the Lower Fox River/Green Bay Remedial Investigation, Feasibility Study, Proposed Remedial Action Plan, and Record of Decision*, (attached to the RS for OUs 1 and 2), increases in average sediment bed elevation occurred over a 2-year period in this section of the River. Also see *White Paper No. 3 – Fox River Bathymetric Survey Analysis* and responses to Master Comments 2.19 and 6.4 in the RS for OUs 1 and 2.

Regarding the commenters' second point, that wLFRM treats SMUs in the central channel of OU 4 as erosional, while FoxSim does not: see the response to Master Comment 6.24 for a brief history of the wLFRM model and its development. The Model Documentation Report, which includes a series of technical memoranda developed by the Model Evaluation Workgroup, in which the FRG was a collaborative participant, also provides detailed analyses of key aspects of model development such as solids and PCB loads, sediment transport dynamics, and initial conditions.

The wLFRM describes PCB transport in all 39 miles of the Lower Fox River, from Lake Winnebago to the River mouth at Green Bay, in a single spatial domain. During the comment period, the FRG provided a new hydrodynamic model (FoxSim) for the first time. FoxSim was not subject to the same degree of scientific scrutiny and peer review as was wLFRM. The WDNR reviewed

FoxSim and found that it contained high uncertainties in its ability to predict PCB fate and transport in OU 4. In addition, the WDNR found that the model has a bias because it was constructed to "evaluate the ongoing and future natural attenuation of the system," which is accomplished through the model's prediction of deposition of clean sediments and less scour of contaminated sediments. However, as stated above and supported in the response to Master Comment 6.23, OU 4 is both depositional and erosional. The conclusions of the WDNR's review of FoxSim can be found in *White Paper No. 15 – FoxSim Model Documentation*, which is attached to the RS for OUs 1 and 2.

The WDNR and EPA believe that the wLFRM model is the appropriate transport model for the Lower Fox River and Green Bay Site. With respect to the ability of the wLFRM to appropriately track sediment PCB concentrations during the calibration period, White Paper No. 16 noted that simulated reach-averaged surface sediment PCB levels in the wLFRM fall within, and never exceed, the 95 percent confidence intervals of observed PCB levels. Considering the area between the De Pere dam and the River mouth (OU 4), the upper 95 percent confidence limit of the observations is more than 60 percent larger than the average. Model results for OU 4 never exceed the 95 percent confidence limit of observed PCB levels for this reach. The small (~1 ppm) difference in model results over time is more a reflection of the spatial heterogeneity of the observations than any failure of the model to appropriately track surface sediment PCB levels.

For further discussion of this topic, please also see response to Master Comment 6.7 in the RS for OUs 1 and 2.

Reference

WDNR, 1999. *Technical Memorandum 2g: Quantification of Lower Fox River Sediment Bed Elevation Dynamics through Direct Observations*. Wisconsin Department of Natural Resources, Madison, Wisconsin. July 23.

6.3 FRFood and GBFood Models

Note: Comments concerning GBFood are included in this section.

Master Comment 6.27

Some commenters stated that the data in the FRFood model, used for developing sediment-to-water ratios, indicate that there could be a trend of decreasing ratios moving downstream (ratio around 10^{-6} upstream of Little Rapids; around 10^{-5} below Little Rapids). Based on this analysis, the

commenters assert that the upstream sections of the River are the source and the downstream sections are the sink for PCBs.

Response

As documented in the BLRA and in the Fox River Food (FRFood) Model Documentation Report, sediment-to-water ratios were developed as a generalized term. These ratios relate the concentration of total PCBs in filtered water relative to that found in the sediments. The same water and sediment data used to calibrate the mass balance for the Lower Fox River were used to estimate these ratios. The commenters appear to be referring to Table 3-7 in the FRFood documentation memorandum based on their inference that there is a decreasing trend in ratios from upstream to downstream. The ratios were developed from the average sediment values computed for the calibration period of 1989 through 1990. For the Lower Fox River, the data suggest that the non-particulate water PCB concentration is between 10^{-6} and 10^{-7} of the bedded sediment concentration. For the De Pere to Green Bay Reach (Green Bay Zone 1), the value lies between 10^{-4} and 10^{-6}, which is the opposite of the conclusion the commenters reached. Using the general term (10^{-6}) in FRFood, the model calibrated very well to the observed data in all reaches of the River. The FRFood report also acknowledged the uncertainty associated with the sediment-to-water ratio and noted that SQTs could differ by an order of magnitude. For example, No Observed Adverse Effects Concentration SQTs for walleye based on a sediment-to-water ratio of 10^{-5} are eight times less than SQTs based on a sediment-to-water ratio of 10^{-6} and 25 times less than an SQT based on a sediment-to-water ratio of 10^{-7}. Please also see the response to Master Comment 3.20 in the RS for OUs 1 and 2.

Master Comment 6.28

A commenter stated that GBFood cannot accurately represent the trends in fish tissue PCB concentrations in Green Bay, because it is based on “errors” in wLFRM and the Green Bay sediment bed map interpolation, compounded by “errors” in GBTOXe.

Response

The Agencies believe that the combined bed maps and transport models for the River and Green Bay provide an adequate basis for the forecasts from the GBFood model. The commenter does not specifically state or list inadequacies with GBFood, but rather points to alleged problems in wLFRM, GBTOXe, and the Green Bay bed maps. The summary position of the Agencies is that the combined models and bed maps accurately represent the

critical features of the overall Site conditions. The Agencies previously responded to critiques of the wLFRM model in Section 6.2 of the RS for OUs 1 and 2 and *in White Paper No. 16 – wLFRM Development and Calibration for the Lower Fox River/Green Bay Remedial Investigation, Feasibility Study, Proposed Remedial Action Plan, and Record of Decision*. Issues related to GBTOXe are addressed in the responses to Master Comments 6.24 and 6.25. Bed map inputs to the modeling process are addressed in the responses to Master Comments 5.71 and 6.24.

Master Comment 6.29

Commenters stated that neither FRFood nor GBFood should be used to derive SQTs.

Response

The WDNR and EPA disagree with this comment. The commenters are in error in stating that GBFood was used to set SQTs; only FRFood was used to derive SQTs. As noted in Master Comment 6.15 of the RS for OUs 1 and 2, the underlying Gobas algorithms applied in FRFood have been successfully applied at several Superfund sites and in the development of the Great Lakes Water Quality Initiative criteria. The Agencies believe that the Gobas algorithms are demonstrably applicable in evaluating bioaccumulation.

The Agencies also believe that FRFood is appropriately applied to setting SQTs. Guidance from EPA Region 5 was provided on the use of bioaccumulation models for setting sediment cleanup goals in the Great Lakes (Pelka, 1998). However, it is important to note that SQTs are not sediment cleanup goals. SQTs should be considered as receptor-specific point estimates (i.e., SQTs are calculated for a specific sediment location, pathway, and receptor). The SQTs themselves are not cleanup criteria, but are a good approximation of protective sediment thresholds and were considered to be "working values" from which cleanup goals were selected. SQTs do not vary by OU, but may vary by Superfund site, given the type of contamination, the types of species, site-specific exposure potential, the location-specific information available at a specific Superfund site, and other factors. The WDNR and EPA believe that the SQTs developed for the Lower Fox River and Green Bay Site are specific Site-wide.

See also the response to Master Comment 4.8 of the RS for OUs 1 and 2 and *White Paper No. 11 – Comparison of SQTs, RALs, RAOs, and SWACs for the Lower Fox River*.

Reference

Pelka, A., 1998. Bioaccumulation models and applications: Setting sediment cleanup goals in the Great Lakes. *Proceedings of the National Sediment Bioaccumulation Conference*. 5-9–5-30.

7 Potential In-River Risks from Remedial Activities

Section 7 of the RS for OUs 1 and 2 included the following subsections:

- *7.1 Habitat Impacts from Dredging and Capping*
- *7.2 Water Quality*

The RS for OUs 3, 4, and 5 follows the same general organization as the RS for OUs 1 and 2. However, many of the comments addressed in the RS for OUs 1 and 2 are generally applicable to the entire Lower Fox River and Green Bay Site and so are not repeated here. Because there are no new comments associated with Section 7.1, that section is not included in the RS for OUs 3, 4, and 5. Prior comments associated with that section can be found in the RS for OUs 1 and 2, which is available on the WDNR website, in the various information repositories, and in the Administrative Record for the Site. The WDNR's website address is: http://www.dnr.state.wi.us/org/water/wm/lowerfox/rifs/index.html.

Section 7 of the RS for OUs 1 and 2 included Master Comments 7.1 to 7.23. Master Comment 7.24 is therefore the first comment in the RS for OUs 3, 4, and 5.

7.2 Water Quality

Master Comment 7.24

Commenters expressed concern that dredging would increase PCB concentrations in Green Bay fish. Their concerns included localized sources of recontamination from PCB resuspension (resulting from dredging and sloughing of side slopes) and resettling of suspended solids and subsequent export to Green Bay.

Response

There is little empirical evidence on the percentage of PCB loss during dredging or the effects of such losses. In dredging at SMU 56/57, which is the most comprehensive data set available, the PCB loss approximated 2.2 percent of the mass removed. The Agencies believe that 98 percent of the PCB mass will be contained during dredging (i.e., a 2 percent PCB loss), which is acceptable.

As shown in the FS, if loss rates from the most highly contaminated site on the River are applied to the entire Lower Fox River, proposed remediation would equate to a loss of 644 kg (1,420 pounds) of PCBs. On the other hand, the FRG offered that the annual PCB export from July 2000 to July 2001 was up to 106 kg (233 pounds) and that the rate of decline approximates a half-life of 9 years. If this rate of decline is accepted and applied to the next 20 years, it would mean that active remediation would result in almost 30 percent less PCBs resuspended and transported to Green Bay than would taking no action.

During the SMU 56/57 demonstration project, the FRG documented increased turbidity and directly measured elevated PCB concentrations resulting only from movement of the coal boat. The authors concluded that "vessel movement is a continuing PCB transport mechanism regardless of dredging operations" (USGS, 2000). Because the sediment is the only possible source of the elevated suspended solids and PCBs, these data document that commercial ship traffic has the potential to locally scour sediments.

The Agencies have therefore concluded that a 2 percent contribution of PCBs to the downstream bed sediments is insignificant compared to the mass of PCBs already contained in the surface sediments. Similar comments, and appropriate responses, were also presented in the Hudson River Responsiveness Summary, Master Comment 587. See also *White Paper No. 8 – Habitat and Ecological Considerations as a Remedy Component for the Lower Fox River,* which is attached to the RS for OUs 1 and 2, as well as the responses to Master Comments 7.14 and 7.15 in the RS for OUs 1 and 2.

Reference

USGS, 2000. *A Mass Balance Approach for Assessing PCB Movement During Remediation of PCB-Contaminated Deposit on the Fox River, Wisconsin, SMU 56/57 1999 Dredging Demonstration Project*. United States Geological Survey Water Resources Investigation Report No. 00-4245. December.

8 Implementability of Remedial Alternatives

Section 8 of the RS for OUs 1 and 2 included the following subsections:

- *8.1 Implementability of Dredging*
- *8.2 Dredging Schedule and Production Rates*
- *8.3 Dredge Material Disposal*
- *8.4 Safety Concerns and Community Concerns*

The RS for OUs 3, 4, and 5 follows the same general organization as the RS for OUs 1 and 2. However, many of the comments addressed in the RS for OUs 1 and 2 are generally applicable to the entire Lower Fox River and Green Bay Site and so are not repeated here. Because there are no new comments associated with Section 8.3, that section is not included in the RS for OUs 3, 4, and 5. Prior comments associated with that section can be found on the WDNR website, at the various information repositories, and in the Administrative Record for the Site. The WDNR's website address is: http://www.dnr.state.wi.us/org/water/wm/lowerfox/rifs/index.html.

Section 8 of the RS for OUs 1 and 2 included Master Comments 8.1 to 8.39. Master Comment 8.40 is therefore the first comment in the RS for OUs 3, 4, and 5.

8.1 Implementability of Dredging

Master Comment 8.40

A commenter requested that the WDNR strengthen measures to reduce the volatilization of PCBs into the air during dredging and at the final disposal site.

Response

The WDNR and EPA recognize the potential for loss of PCBs to the atmosphere during removal, handling, and disposal of River sediments. However, the identification, use, and implementation of control measures to minimize volatilization are more appropriately addressed during the remedial design phase, following issuance of the ROD. Hydraulic dredging can be effectively engineered to minimize volatilization, and hydraulic and mechanical dredging technologies have been demonstrated to provide a protective and environmentally beneficial result (FS, Appendix B). Therefore, either technology is appropriate for the removal of PCB-contaminated

sediments from the Lower Fox River. In addition, air monitoring will be incorporated into the various on-water and upland activities during implementation to address community and workers' concerns.

Recognizing the results of the air monitoring conducted during the dredging project at SMU 56/57 (WDNR, 2000), the Agencies have determined that activities associated with implementing the Proposed Plan will not result in unacceptable risk as a result of PCB losses to the atmosphere. Ambient concentrations observed during the 24-hour sampling regime ranged from less than 0.2 nanograms per cubic meter (ng/m^3) to 79.7 ng/m^3 during the dredging and sediment processing. Ambient concentrations within the property boundaries of the remediation area ranged from approximately 0.7 ng/m^3 to 79.7 ng/m^3, while off-property concentrations reached a maximum of only 3.6 ng/m^3. The highest concentration recorded on site was less than 80 percent of the conservative risk level, while off-site risks never exceeded 4 percent. Twenty-nine of 31 samples collected adjacent to the landfill accepting the dredge material from SMU 56/57 had no detectable PCBs. In the two samples in which PCBs were detected, PCB concentrations were not significantly different from concentrations in background samples also collected in the area.

These data show that during remediation of the most highly contaminated sediments in the Lower Fox River (SMU 56/57), volatilization did not reach a level that posed a risk to human health. The FRG concluded that "although increases in ambient air PCB concentrations were observed near the sediment dewatering area, estimated PCB emissions and resulting concentrations were found to be relatively small and insignificant relative to human exposure and risk" (BBL, 2000).

At SMU 56/57, sediments averaged 20.8 grams PCBs per cubic yard (g/cy) based on the reported PCB mass of 654 kg (1,442 pounds) and an *in-situ* sediment volume removed of 31,500 cy. In contrast, the proposed remedial plan averages only 4 g/cy (29,259 kg [64,516 pounds]/7.25 million cy). If one assumes a volatilization rate equal to that observed during the SMU 56/57 dredging project, the sediments to be handled during the entire remediation are less than one-fifth as concentrated; therefore, the mass of PCBs lost during the entire remediation period (125 kg [275 pounds]) would be less than that estimated in the GBMBS for just 1989/1990 (154 kg [340 pounds]).

Despite these considerations, which indicate that volatilization is readily controllable and should not result in a significant release, monitoring would be conducted as a final measure to ensure protectiveness of the selected remedy.

References

BBL, 2000. Major Contaminated Sediment Site Database. Last updated August 1998. Website: http://www.hudsonvoice.com.

WDNR, 2000. Fox River Remediation Air Monitoring Report, Ambient PCBs During SMU 56/57 Demonstration Project, August–November 1999. WDNR Publication Number PUBL-AM-310-00. Wisconsin Department of Natural Resources.

Master Comment 8.41

A commenter stated that remedy effectiveness relies on the unstated assumption that dredging efforts can be expected to be 100 percent efficient at removing contaminated sediments to specified action limits.

Response

The WDNR acknowledges that some sediment loss will occur during dredging operations; however, such loss will be minimal. At SMU 56/57, the PCB loss approximated 2.2 percent of the mass removed. The WDNR and EPA believe that this loss rate is the most applicable rate for the entire Lower Fox River. Applying the loss rate from SMU 56/57 to the proposed remediation would equate to a total loss of approximately 644 kg (1,420 pounds) of PCBs (2.2 percent of 29,259 kg [64,516 pounds] PCBs). In Appendix B of the FS, the *Sediment Technologies Memorandum* provided a comprehensive evaluation of dredging projects and concluded that dredging has been successfully implemented at various sites. There have been over 100 years of experience with dredging projects around the world.

As stated in the FS, 17 of the 20 projects cited in Appendix B met the short-term target goals that included sediment excavation to chemical concentration, mass, horizon, elevation, or depth compliance criteria. Seven projects had "overdredge" designed into the project plans. In five out of seven cases where overdredge could occur, target goals were met. The Port of Los Angeles hydraulically dredged and landfilled about 29 million cy of sediment for the Pier 400 construction project (1994 through 2000). Projects at Minamata Bay, Japan, and Lake Ketelmeer, Netherlands, two of the largest international contaminated sediment dredging projects known to the WDNR and EPA, involved dredging 1 million cy of mercury-impacted sediment in 4 years and 1.9 million cy of impacted sediment in 1 year, respectively. The Ketelmeer project covers a larger area and volume than does the proposed action for the Lower Fox River and is already well into the construction phase (Roukema et al., 1998). Other large contaminated sediment management projects include the Slufter Depot for the Port of Rotterdam and restoration of Lake Tunis in

Tunisia. Sediment remedial projects in the United States that will be similar in scale to the Lower Fox River project include the removal action on the Hudson River in New York, the Hylebos and Thea Foss waterways in Washington, and the Kalamazoo River in Michigan. The "lessons learned" from these dredging projects were considered while preparing the FS. Based on the experiences at previous dredging projects, hydraulic (cutterhead suction dredge) and mechanical dredge (clamshell bucket) were considered in the FS.

Results from the *Sediment Technologies Memorandum* (Appendix B of the FS) indicate that dredging can be implemented in an effective way if the technology is designed and managed appropriately for Site conditions. In addition, the WDNR and EPA have determined that removal and disposal of approximately 780,000 cy of contaminated sediments in OU 1 is protective, implementable, and cost-effective. The ROD for OUs 3, 4, and 5 provides for the removal by dredging of 586,800 cy of contaminated sediments containing 1,111 kg (2,444 pounds) of PCBs from OU 3 and the removal of Deposit DD from OU 2 as part of the OU 3 remedy. Deposit DD adds approximately 9,000 cy of contaminated sediment and 31 kg (68 pounds) of PCB mass to the OU 3 project. It is estimated that OU 4 contains approximately 26,650 kg (58,620 pounds) of PCBs in 8,491,400 cy of sediment. The ROD for OUs 3, 4, and 5 provides for the removal by dredging of 5,879,500 cy of contaminated sediments containing 26,433 kg (58,150 pounds) of PCBs from OU 4.

Reference

Roukema, D. C., J. Driebergen, and A. G. Fase, 1998. *Realisation of the Ketelmeer Storage Depot.* Terra et Aqua 71. Website: http://www.iadc-dredging.com/terra%2Det%2Daqua/1998/71%2D3.htm.

Master Comment 8.42

Commenters expressed concerns over the technical feasibility of the removal remedy for OU 3 and OU 4 in the Proposed Plan. The commenters also expressed concern over the dredging costs and that they would be significantly more than MNR in the downstream portion of OU 4.

Response

The WDNR and EPA disagree with this comment. Projects that utilize at least one of the basic components of the alternative offered in the Proposed Plan — dredging, pipeline, and passive dewatering followed by disposal — are commonly implemented. Navigational dredging projects commonly dredge large volumes of sediment in short time frames. Typically, about 4 million cy of sediments are dredged by the USACE each year from Great Lakes harbors

and channels, which is only a portion of the 300 to 350 million cy dredged by the USACE nationwide annually. On average, the USACE spends about $20 million annually for dredging and dredged material management in the Great Lakes basin (USACE website: http://www.lrd.usace.army.mil/gl/dredge.htm). Other large international and U.S. projects are described in the response to Master Comment 8.41 and detailed in Appendix B of the FS.

Pipeline technology has been used to transfer sediment dredge slurry over long distances, a common practice in mining facilities and at dredging operations. An example is the White Rock Lake project in Dallas, Texas. In this project, a 20-mile pipeline was used to transport dredged sediments over land. At the USX portion of the Grand Calumet River project, a 3-mile in-water pipeline with an 18-inch diameter is being used. In a Wisconsin case, hydraulically dredged sediments were transferred via pipeline from the Grubers Bay Grove sediment project, part of the U.S. Army Badger Army Ammunition Plant remediation, to the on-site disposal location, a distance of about 0.7 mile. Although it's important to note that no route has yet been selected for the pipeline for the Lower Fox River project, it is possible to place the pipeline adjacent to an existing recreational route, in the River, or along public rights of way (or at some combination of the three). Pipeline routing will be a challenge. The specific route and details concerning the design and construction of a pipeline along any specific route or combination of routes is a design consideration that will be addressed in the final remedial design phase of the project.

Passive dewatering and disposal represent a feasible "low-tech" approach for dewatering sediments. In this particular alternative, the technology application relies on gravity settlement of solids, which would be conducted in upland ponds. This approach is consistent with the approach used at Brown County's Bayport facility for the management of navigational dredge materials in conjunction with mechanical dredging. Use of passive dewatering cells can lead to a need for large land areas; finding a location for such a facility will be undertaken during the remedial design phase.

Concerning the cost of dredging, the WDNR has reviewed the overall cost estimates for the OUs 3 and 4 remedy, as described in the Proposed Plan. This cost evaluation is documented in *White Paper No. 23 – Evaluation of Cost and Implementability of Alternative C2B for Operable Unit 3 and Operable Unit 4,* which is attached to this RS. As a result of that cost evaluation, the cost estimates for the OUs 3 and 4 alternative increased by about 42 percent, from an estimated $200.5 million to approximately $284 million. The Agencies believe that these cost estimates are reasonable and provide a protective remedy. The estimated costs proposed for the remediation are within an acceptable range per federal Superfund guidance. The WDNR and EPA are confident that the proposed costs of the remediation

and monitoring activities are within the cost estimation criteria of –30 percent to +50 percent found in Superfund guidance.

Critical to the success of this alternative is linking these technologies together. The inability to implement any individual portion (such as pipeline or passive dewatering cells) could result in increased cost for this approach.

Reference

Roukema, D. C., J. Driebergen, and A. G. Fase, 1998. *Realisation of the Ketelmeer Storage Depot*. Terra et Aqua 71 Website: http://www.iadc-dredging.com/terra%2Det%2Daqua/1998/71%2D3.htm.

Master Comment 8.43

A commenter stated that daily effective production in OU 3 and OU 4 cannot reasonably be greater than 12 hours because OU 3, OU 4, and the surrounding areas where land-based dewatering, staging, and trucking operations will occur are in residential neighborhoods. Consequently, the proposed remedy cannot meet its goal in a timely way.

Response

As indicated in the FS, the dredge operations for OUs 3 and 4 are limited to 12 hours per day. Dredge and disposal via pipeline allows for 24-hour dewatering operations. However, the dewatering operations will be limited to a location in proximity to the disposal facility to minimize or avoid the impact of remediation activities on host communities. The case studies presented in Appendix B of the FS indicate that the dredge rates suggested in the Proposed Plan are not unreasonable. The commenters assume that only one dredge will operate at any single time in either OU 3 or OU 4. This is incorrect. There are no restrictions to prevent multiple dredges. The FS describes two 12-inch cutterhead dredges operating simultaneously 12 hours per day, 7 days per week, 26 weeks per year, and a dredge rate of 120 cubic yards per hour (cy/hr) per dredge (240 cy/hr for two dredges). The resulting dredge duration is 102 days or 0.7 year. For OU 4, the FS describes two 12-inch cutterhead dredges operating simultaneously 12 hours per day, 7 days per week, 26 weeks per year, and a dredge rate of 120 cy/hr per dredge (240 cy/hr for two dredges). The resulting dredge duration is 1,019 days or 6.8 years. Please also see the FS and the response to Master Comment 8.15 in the RS for OUs 1 and 2. See the response to Master Comment 8.15 in the RS for OUs 1 and 2 for further discussion of the issue of dredge production rates.

Master Comment 8.44

Commenters believe the FS and Proposed Plan recognize the possibility of effective combinations of natural attenuation, capping, dredging, and off-site disposal. However, the commenters do not believe that alternative treatment technologies (such as detoxification through high-temperature thermal desorption) and combinations of other alternatives were adequately considered.

Response

The WDNR and EPA disagree with this assessment. The remedy decision is based on risk reduction, and the RI/FS is an objective, unbiased approach to analyzing remedial alternatives. The level of detail provided in the FS and the supporting documents is consistent with Superfund guidance. The FS provides thorough evaluations of the feasible and applicable technological alternatives. The FS technology evaluation is followed by the development of feasible alternatives prior to selection of a remedy and further Site-specific design of the selected remedial alternative. The FS looked at and evaluated numerous technologies and combinations of technologies for remedial purposes. These technology evaluations and alternative assessments are in Sections 6 and 7 of the FS and are also discussed in the Proposed Plan.

Furthermore, Section 7.6 of the FS identifies vitrification as the representative thermal treatment process option. Also discussed in Section 6 of the FS is a multiphase study conducted by the WDNR on sediment from the Lower Fox River to determine operational data, treatment effectiveness, and cost-effectiveness of vitrification. The results from the multiphase study demonstrate that thermal treatment is a feasible option for the treatment of dredged sediment. Data generated by the EPA's Superfund Innovative Technology Evaluation program shows that vitrification does not generate dioxins and furans in the off-gases from these technologies and is greater than 99.9999 percent effective at destroying PCBs.

Master Comment 8.45

Comments were received concerning the presence of and importance of taking into consideration various physical obstacles, such as water intakes, outfalls, piles, cables, and pipelines, in upstream and downstream portions of OU 4 in planning for a remedial action. Commenters submit that the FS and Proposed Plan did not evaluate the impact on the proposed remedy of any of these obstacles with regard to cost, effectiveness, and implementability.

Response

The WDNR acknowledges that there will be physical obstructions in the downstream portion of the Lower Fox River that will need to be dealt with in any implemented remedial alternative. However, two environmental dredging pilot projects performed on the River over the period 1998 to 2000, as well as detailed monitoring of the River and of the water withdrawn by nearby industries, have shown no risk to the quality of water withdrawn for industrial uses. The WDNR and EPA have conducted the pilot projects to demonstrate that dredging can be accomplished on the River in an effective fashion with minimal disruption of industry or the community. The WDNR is unaware of any industrial water intake quality issues in the River associated with either navigational or environmental dredging projects on the Lower Fox River. The USACE performs regular navigational dredging on the lower portion of the River, and the WDNR has not been notified of any problems concerning water intakes, outfalls, piles, cables, pipelines, etc. In addition, as part of the pre-design phase of this project, the WDNR and EPA, in cooperation with various utility companies and municipalities, are identifying areas of the River and Bay that could contain obstructions.

The *Sediment Technologies Memorandum* documented that debris management is an important component of remedy design. In the draft FS, obstruction removal was not specifically accounted for. In the final FS, the costs associated with debris sweeps have been specifically accounted for.

Master Comment 8.46

Several commenters expressed concern over the use of silt curtains to control resuspension losses during dredging in OU 4. Included were comments that support the use of anchored silt curtains at all sites, as outlined in the FS. Other commenters stated that silt curtains would be difficult to implement, would not provide additional protection, and have a poor application record at the demonstration projects.

Response

These issues were addressed specifically for OU 1 in the response to Master Comment 8.8 in the RS for OUs 1 and 2; that response is also relevant for OU 3 and OU 4 and so is cross-referenced here. Although the use of silt curtains was applied throughout the FS as a process option for the entire River when developing the alternatives and costs, the FS did indicate that silt curtains may not be appropriate at all sites. Silt curtains were also applied during the demonstration project at SMU 56/57. As commenters correctly point out, factors such as currents, the ability to anchor, obstructions, and interference with navigation will need to be considered in the final design.

Whether silt curtains are needed or should be used in the Lower Fox River is a design issue and will be determined by the design engineer and dredge contractor.

8.2 Dredging Schedule and Production Rates

Master Comment 8.47

Commenters stated that the Proposed Plan's estimated dredging rates are too optimistic and are not typical of environmental dredging rates for OU 3 and OU 4. The commenters assert that more appropriate rates would be 200 cy/hr for "first pass" dredging and 100 cy/hr for "cleanup pass" dredging, which would also include 8 inches of overdredged sediment. Based on their estimates, commenters stated that OU 3 would require 2.9 years for removal and OU 4 would require 22.1 years. A key assumption was that only one hydraulic dredge can operate at each reach in order to minimize turbidity, total suspended solids and PCB resuspension, and interference with boat and ship traffic.

Response

The case studies presented in Appendix B of the FS indicate that the dredge rates in the Proposed Plan are not unreasonable for environmental dredging. For example, dredge production rates at the SMU 56/57 demonstration project averaged 60 cy/hr and 294 cy/day.

Two types of hydraulic dredges were considered in the FS cost estimates for the Lower Fox River. The average dredge production rate for a 10-inch cutterhead dredge in a 10-hour shift is 105 cy/hr and the average dredge production rate for a 12-inch cutterhead dredge in a 12-hour shift is 120 cy/hr. These dredge rates are within the estimates used by the FRG model (100 to 200 cy/hr) to account for "first pass" and "cleanup pass" dredging.

For OU 3, the FRG assumes one hydraulic dredge operating 12 hours per day, 6 days per week, and 26 weeks per year. This results in a dredge time frame of 454 days or 2.9 years (based on a 156-day dredge year: 26 weeks × 6 days per week). For OU 3, the FS describes two 12-inch cutterhead dredges operating simultaneously 12 hours per day, 7 days per week, 26 weeks per year, and a dredge rate of 120 cy/hr per dredge (240 cy/hr for two dredges). The resulting dredge duration is 102 days or 0.7 year, lower than the FRG's time frame due to a higher dredge rate.

For OU 4, the FRG assumes one hydraulic dredge operating 12 hours per day, 6 days per week, and 26 weeks per year. This results in a dredge time frame

of 3,448 days or 22.1 years. For OU 4, the FS describes two 12-inch cutterhead dredges operating simultaneously 12 hours per day, 7 days per week, 26 weeks per year, and a dredge rate of 120 cy/hr per dredge (240 cy/hr for two dredges). The resulting dredge duration is 1,019 days or 6.8 years, lower than the FRG's time frame due to a higher dredge rate.

The commenters' argument that only one dredge can operate at any single time in either OU 3 or OU 4 is not a supportable position; there are no restrictions to prevent multiple dredges from operating in any OU. The ROD recognized that expediting activities and possible work in multiple OUs within the Lower Fox River and mouth of the Bay is highly desirable. See the response to Master Comment 8.15 in the RS for OUs 1 and 2 for further discussion of the issue of dredge production rates.

The WDNR acknowledges that some sediment loss will occur during dredge operations; however, such loss will be minimal. At SMU 56/57, the PCB loss approximated 2.2 percent of the mass removed. The WDNR and EPA believe that this loss rate is the most applicable rate for the entire Lower Fox River. On the basis of experiences at previous dredging projects, hydraulic (cutterhead suction dredge) and mechanical dredge (clamshell bucket) were both considered in the FS. Results from the *Sediment Technologies Memorandum* (Appendix B of the FS) indicate that dredging can be implemented in an effective way if the technology is designed and managed appropriately for the Site conditions.

As noted in the response to Master Comment 8.51, the Agencies do not believe that dredging in OU 4 will restrict or otherwise obstruct commercial shipping or docking activities. The WDNR and EPA have conducted the pilot projects to demonstrate that dredging can be done on the River in an effective fashion with minimal disruption of industry or the community.

8.4 Safety Concerns and Community Concerns

Master Comment 8.48

A commenter stated that cleanup work must begin as soon as possible, with multiple dredging crews working simultaneously at several sites along the River and in the Bay, to make the cleanup as speedy as physically possible.

Response

The WDNR and EPA would also like to see active in-water remediation take place quickly. Toward that end, the WDNR and EPA have conducted pilot

projects to demonstrate that dredging can be accomplished on the River in an effective fashion with minimal disruption of industry or the community. The ROD recognized that expediting activities and possible work in multiple OUs in the Lower Fox River and mouth of the Bay is highly desirable. The Agencies believe that addressing continuing PCB discharge into Green Bay will assist in reducing the long-term risks in Green Bay.

Master Comment 8.49

A commenter suggested that a remedy tailored to the upstream and downstream conditions of OU 4 should be selected. The commenter also expressed concern that dredging may pose substantial risk to the community and workers, given the amount of materials handling involved.

Response

Implementation of the selected remedy for OU 4 (Alternative C2B – dredging followed by passive dewatering and disposal into a monofill) will be operationally the same for all of OU 4. Although some characteristics in this reach of the River vary, the fundamental nature of the River and the River sediments is essentially the same. Thus, the selected technology can be applied to upstream and downstream areas within OU 4, and there is no reason for separate remedies within this reach.

Risks to the community and to workers were considered in the FS and will be addressed via proper project design and a health and safety plan. Worker and community safety is routinely considered during Superfund projects and can be readily addressed with proper site management and planning.

Master Comment 8.50

Commenters stated that dredging could disrupt the small amount of habitat present in OU 4 for years to come.

Response

Many aspects of the concerns expressed by these commenters are addressed in the response to Master Comment 7.3 in the RS for OUs 1 and 2. Locations of and potential impacts and enhancements to habitat and wildlife resulting from removal are also evaluated in Section 2 of the BLRA, Section 8 of the RS for OUs 1 and 2, and in *White Paper No. 8 – Habitat and Ecological Considerations as a Remedy Component for the Lower Fox River,* which is attached to the RS for OUs 1 and 2. The potential impacts on Lower Fox River habitats have been realistically characterized and evaluated. Habitat

loss was considered during remedy selection. It has been determined that potential impacts on terrestrial habitat are nonexistent. It has also been determined that fish in the Lower Fox River will not experience impacts from any remedy that has been proposed.

The WDNR and EPA have stated that ecosystem restoration and rehabilitation are critical components for the Lower Fox River and Green Bay Site. As discussed in White Paper No. 8, fish in the Lower Fox River utilize open substrate such as cobble with high dissolved oxygen for spawning and adult habitat. These areas are not targeted for dredging. Areas targeted for dredging or capping in the Lower Fox River are predominantly soft, aqueous, and silty sediments. Further, as previously noted in Master Comment 7.4 of the RS for OUs 1 and 2, "the NRDA [Natural Resources Damage Assessment] restoration will target habitat enhancements, which are consistently called for by WDNR. Habitat enhancements contained in the remedy support the diversification of the fish assemblages within the River and the creation of more nearshore, shallow littoral habitat." Dredging and capping remedies have been shown to have rapid recovery and minimal impact on aquatic communities. The commenters have suggested that risk will be increased by remediation, when actually the risk will not increase — the remedy will present less risk potential than the level of risk currently present.

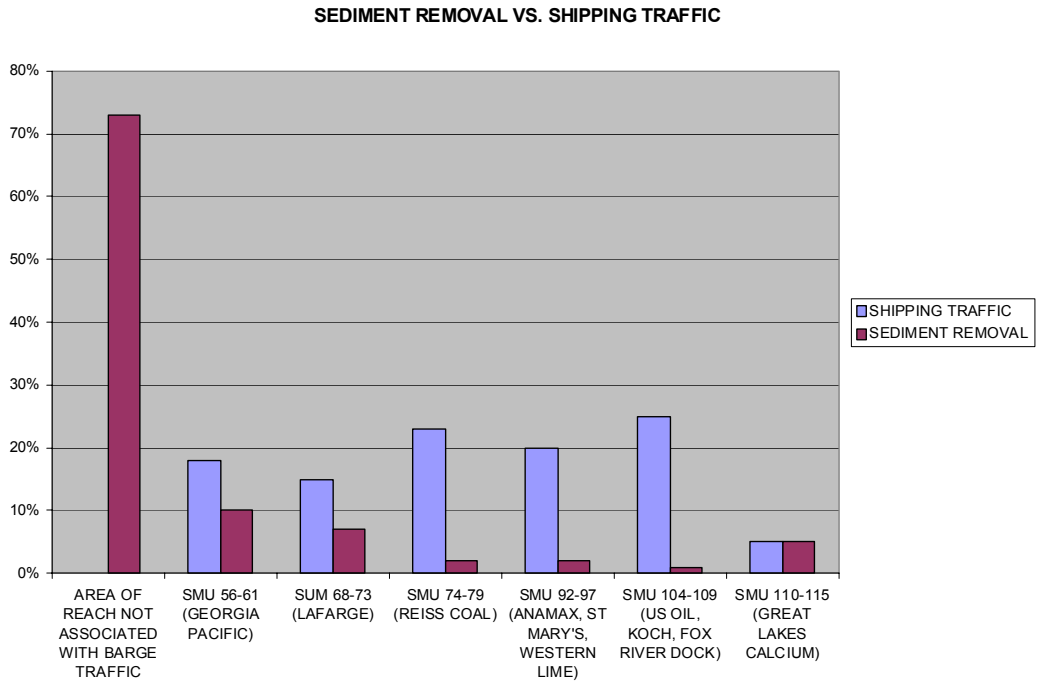
Master Comment 8.51

Commenters stated that environmental dredging would have a significant impact on commercial shipping in OU 4 due to obstruction of commercial docks. They also stated that the resuspension of sediments from environmental dredging has the potential to interfere with industrial processes requiring clean intake water. These commenters also expressed concern about shoreline stability and recreation.

Response

The Agencies do not believe that dredging in OU 4 will restrict or otherwise obstruct commercial shipping or docking activities. Dredging would occur in a relatively small area at any given time and would not likely block a commercial shipping area or docking facility for very long. Regarding the possible obstruction of commercial dock traffic, only 27 percent of sediment to be removed from OU 4 is in SMUs having commercial facilities that receive shipping traffic. Based on 2001 and 2002 data from the Green Bay Port Authority, SMUs with the highest traffic are located close to the mouth of the River, and more than 50 percent of the River traffic is limited to within the first River mile (SMU Groups 92–115). In fact, more than 50 percent of the

shipping traffic occurs where less than 10 percent of the contaminated sediment targeted for removal in OU 4 is found (see figure below).



The scope of remedial work in OU 4 will require dredging of the River in areas adjacent to the navigation channel, but dredging within the navigable channel will be negligible considering previous dredging operations conducted by the USACE. The depth of the River in the area of commercial traffic is such that the dredge will be maneuverable outside of the shipping channel, thus enabling the dredge to operate along the edges of the waterway outside of the navigation channel. Therefore, environmental dredging will not impede shipping traffic within the ship channel.

All appropriate and mandatory marking devices, navigation notices, and communication links will be of standard and legal operating protocol to properly notify incoming traffic.

In areas of high shipping traffic and where slips may be blocked, submerging the dredge pipe is an option. In the SMU 56/57 project, submersion of the dredge pipeline across the Fort James boat slip was considered, although a conscious design choice was made not to submerge the dredge pipe, thus requiring disruption of dredging operations during entry and departure of the coal boat. Taking this into account, the volume of dredging that will occur in high traffic areas may call for sinking the dredge pipe to ensure efficient use of the waterway by both shipping and dredge operations.

Although dredging will occur during the entire shipping season, 73 percent of the scope of the dredging is targeted for areas of the River with commercial ship traffic. The frequency of traffic coming into each port has been taken into consideration, and coordination of shipping traffic and dredging operations can be scheduled. The design and route of the dredge pipeline will be considered during the remedial design phase, as will the scheduling of dredging activities to coordinate with ship arrivals and departures when working in the vicinity of active docks. Past navigational and environmental (pilot project) dredging have been performed without interference to commercial navigation. The WDNR and EPA have every reason to believe that future dredging projects can be implemented in a manner that fully accommodates commercial shipping needs.

The two environmental dredging pilot projects performed on the River at Deposit N and SMU 56/57 provided detailed monitoring information for the River and of the water withdrawn by nearby industries; that monitoring information shows no decrease to the quality of water withdrawn for industrial uses. No large industrial water users have raised concerns to the WDNR about actual problems with the quality of incoming water or their ability to withdraw water from the River arising out of either navigational or environmental dredging projects. The WDNR and EPA recognize the need to protect industrial water intakes and measures to do so will be incorporated into the remedial design.

The USACE performs regular navigational dredging on the lower portion of the River; the WDNR has not been notified by water users of any problems associated with that dredging. EPA experience on other dredging projects has demonstrated that with proper design and monitoring, these risks can be readily addressed. A January 2002 white paper for the Hudson River Site, "Resuspension of PCBs During Dredging," shows that for five projects representing 388 observations, the average contaminant loss was 0.11 percent. Lower Fox River projects would utilize similar equipment and protective measures and would expect similar results.

Considering the length of shoreline that will be affected by the remedy, the WDNR and EPA estimate minimal change, if any, in shoreline stability. Monitoring of the shoreline and bulkheads at both pilot dredging projects showed no problems with sediment removal close to these structures.

Regarding recreational facilities, marinas, boat landings, and boatlifts, there are four primary recreational areas. The Green Bay Yachting Club and McDonald Marina are both located near the River mouth, where very little sediment removal is targeted. The East River Holiday Inn City Center Marina also is in an area that requires minimal remediation. The Allouez Yacht Harbor is located in an area of the River where 7 percent of the remediation

will take place; however, considering the length of shoreline that will be affected, the inconvenience will be minimal. All of the sediment removal targeted for areas around these marinas can be scheduled for periods of inactivity during the design phase of the project.

Reference

Brown County Port and Solid Waste Department website:
http://www.co.brown.wi.us/solid_waste/port/index.htm.

Master Comment 8.52

Some commenters stated that they oppose dredging of the Green Bay Harbor shipping channel between the De Pere dam and the mouth of the Lower Fox River for several reasons, including:

- This section of the River contains roughly 90 percent of all PCBs in the entire Lower Fox River.
- The USACE channel maintenance equipment is not designed for remedial toxic cleanups.
- The USACE does not have a disposal site that complies with the EPA's Toxic Substances Control Act exemption requirements; the USACE dredges a relatively small quantity of sediment from the channel each year.

Response

This comment seems to combine several issues. The Agencies agree that OU 4 contains a large percentage of the contaminated sediment and PCB mass in the River. However, much of this material is located outside of the navigation channel and consequently is not impacted by the USACE's navigational dredging. Furthermore, there are no plans at this time to utilize the USACE's personnel or navigational dredge equipment or the dredge solids management facility operated by Brown County as part of the remedial action for Green Bay.

The fact that much of the PCB-contaminated sediment is located outside of the navigation channel is key to this issue, as the PCB contamination in the sediments in OU 4 presents an unacceptable risk to human health and the environment. As a result, the scope of the remedial work for OU 4 will require dredging of the River in areas adjacent to the navigable channel, but dredging within the navigable channel will be negligible considering previous dredging operations conducted by the USACE. The depth of the River is such

that the dredge will be maneuverable outside of the shipping channel. Dredging vessels typically draw 3 to 15 feet of water, thus enabling the dredge to operate along the edges of the waterway. Therefore, environmental dredging will not impede shipping traffic within the ship channel.

Regarding the concern of possible obstruction of commercial dock traffic by remedial dredging operations, a minimal amount of sediment removal in the De Pere to Green Bay Reach is necessary in SMUs that have commercial facilities receiving shipping traffic. Six SMU Groups in this reach receive barge traffic. Based on data from 2001 and 2002, the SMU Groups with the highest volume of barge traffic are SMUs 104–109, 92–97, and 74–79. The highest traffic SMUs are located close to the mouth of the River, reducing total River traffic by 50 percent. Based on an analysis of traffic on the Lower Fox River, most shipping traffic occurs close to the mouth of the River; the percentage of sediment removal within these high-traffic areas is minimal.

9 Selection of Remedy

Section 9 of the RS for OUs 1 and 2 included the following subsections:

- *9.1 General Comments*
- *9.2 Cost*
- *9.3 Long-Term Monitoring*

The RS for OUs 3, 4, and 5 follows the same general organization as the RS for OUs 1 and 2. However, many of the comments addressed in the RS for OUs 1 and 2 are generally applicable to the entire Lower Fox River and Green Bay Site and so are not repeated here. The RS for OUs 1 and 2 can be found on the WDNR website, at the various information repositories, and in the Administrative Record for the Site. The WDNR's website address is: http://www.dnr.state.wi.us/org/water/wm/lowerfox/rifs/index.html.

Section 9 of the RS for OUs 1 and 2 included Master Comments 9.1 to 9.24. Master Comment 9.25 is therefore the first comment in the RS for OUs 3, 4, and 5.

9.1 General Comments

Master Comment 9.25

Commenters expressed support for reconstruction of the cap on the Renard Island Confined Disposal Facility (CDF) as part of the remediation of OU 5.

Response

The WDNR and EPA support the appropriate closure of the Renard Island CDF. However, closure of the CDF is the responsibility of the USACE and the local sponsor, Brown County, under the Rivers and Harbor Act and the Water Resources Development Act. The WDNR recognizes that appropriate closure of the CDF includes ensuring that it is properly capped, monitored, and maintained and that it does not become a source of PCBs back into Green Bay. WDNR Waste Program staff will work with the USACE and Brown County to see that the site is properly closed. Closure of Renard Island is not part of the ROD for OU 5.

Master Comment 9.26

Commenters stated that closure of the Renard Island CDF is not properly included in the Superfund process and cannot be identified as part of a remedy for OU 4 or OU 5. Other commenters suggested that the selected remedy for

OU 4 or OU 5 should include the costs of Brown County's financial responsibility for managing Renard Island as well as costs for the Bayport facility operated by the county.

Response

The WDNR and EPA acknowledge that closure of the CDF and operation of the Bayport facility are responsibilities of the USACE and the local sponsor, Brown County, under the Rivers and Harbor Act and the Water Resources Development Act and, as such, are not included in the ROD. Since neither facility was identified in the BLRA as a specific source of risk and since the facilities are subject to other state and federal jurisdiction, the ROD cannot require any remedial action at these facilities.

Brown County has expressed interest in exploring the appropriate closure and long-term care of Renard Island and Bayport as part of the overall Lower Fox River cleanup. Costs for closure of Bayport and the Renard Island CDF are included in Sections 7.5 and 7.6 of the FS along with the cost of constructing a new CDF. Final closure of Renard Island must be agreed to by the USACE, Brown County, and the WDNR. One element of CDF closure will be ensuring that the CDF is properly capped, monitored, and maintained and that it does not become a source of PCBs back into Green Bay.

Master Comment 9.27

A commenter stated that the Bayport facility may be filled within 20 years and that the Proposed Plan is incomplete by not taking into account impacts on operation of the Bayport facility.

Response

The Agencies agree that over time, as navigational dredge material is removed from the River and Bay, there will be less capacity at the Bayport facility. As the local sponsor for the Port of Green Bay, the county has agreed to provide for the disposal of navigational dredge material as part of an operational agreement with the USACE to continue navigational dredging. This agreement with the USACE would be necessary regardless of sediment contamination. However, because of the amount of material to be removed during the remedial effort, less dredging should be required for some time into the future, and it is anticipated that material from the navigational channel will be included in the remedial action, thus extending the life of the Bayport facility. Nonetheless, impacts to operation of the Bayport facility are not an element of the remediation of the Lower Fox River and Green Bay Site.

Master Comment 9.28

Commenters stated that the MNR alternative proposed for OU 5 will leave areas of PCB-impacted sediments that will drift into the navigation channel for decades.

Response

The Agencies have selected MNR for OU 5. In choosing MNR for the Bay, the Agencies considered Superfund guidance on the nine evaluation criteria to determine whether remediation is needed or not. The Agencies considered other information as well.

Data from the Green Bay Port Authority documents that navigational dredge material from Green Bay contains very low levels of PCBs. With significant reductions in the transport of PCBs to Green Bay from the Lower Fox River, PCB concentrations in the southern portion of Green Bay, including the navigation channel, will continue to decline. Sediment drift into the navigation channel is not a compelling reason to require dredging of the southern Bay. Continued navigational dredging coupled with MNR may allow for continued dispersion of contaminated sediment within the lower Bay. In addition, if dredging to a 1 ppm action level occurred within the southern Bay, it is likely that PCB contamination of navigational dredge material would continue.

To address concerns raised about Green Bay, the WDNR undertook several actions, which included reevaluating the PCB mass and contaminated sediment volume in the Bay (documented in *White Paper No. 18 – Evaluation of an Alternative Approach of Calculating Mass, Sediment Volume, and Surface Concentrations in Operable Unit 5, Green Bay*); conducting additional sampling in the south end of the Bay (documented in *White Paper No. 19 – Estimates of PCB Mass, Sediment Volume, and Surface Sediment Concentrations in Operable Unit 5, Green Bay Using an Alternative Approach,* which also provides estimates of PCB mass and contaminated sediment volume incorporating the new data); and conducting additional modeling to evaluate removal of contaminated sediments (documented in *White Paper No. 20 – Green Bay Modeling Evaluation of the Effects of Sediment PCB Bed Map Revisions on GBTOXe Model Results* and *White Paper No. 21 – Green Bay Modeling Evaluation of a Hypothetical Open-Water Disposal Site for Navigational Dredged Material in Southern Green Bay*). All four white papers are appended to this RS.

Results from the additional sampling and the evaluations discussed in White Paper No. 18 and White Paper No. 19 indicate that there were no areas in the southern Bay with elevated concentrations of PCBs.

The modeling results discussed in White Paper No. 20 reveal that changes to PCB mass in Zone 2 of OU 5 do affect the initial conditions for the GBTOXe model; however, the effect is to make those initial conditions more consistent with zones 3A, 3B, and 4 of OU 5. White Paper No. 21 evaluated how sediments dredged from the federally maintained navigation channel and disposed of in the open-water disposal areas that were operated up until the 1970s might have affected PCB distribution in the Bay. That work illustrated how PCBs within a hypothetical dredge material disposal site would be initially high in Zone 2 but would tend to become less appreciable within a 10-year time frame. Furthermore, there is no appreciable impact to sediment and water column PCB concentrations for zones 3A, 3B, and 4. Collectively, these results demonstrate that concerns about elevated PCBs from dredged material disposal are unfounded.

Finally, limited dredging is part of the Green Bay remedy. This dredging will be performed near the mouth of the River, where the highest concentrations in the Bay are located.

Master Comment 9.29

Commenters indicated that siting and constructing a landfill dedicated to the disposal of Lower Fox River sediment would be difficult in southern Brown County; that the cost of shipping dredged sediment out of state would be prohibitive; and that options for siting the pipeline or selecting preferred routes for conveyance of dredged sediment were not addressed.

Response

The WDNR and EPA share these concerns about the potential impacts that this action, as well as future actions, could have on the Fox River Valley and Green Bay community. The WDNR believes that building a disposal facility is feasible; larger landfills do exist in Wisconsin. While siting may be difficult, it can be accomplished with the cooperation of the many parties involved in this effort, including local parties, county and state officials, and the EPA.

The WDNR agrees that tipping and transportation costs would be high if dredged sediments were shipped out of state. However, the WDNR does not foresee this scenario. The WDNR and EPA believe that one of the keys to minimizing remedial costs is to work with the local community and businesses. To begin addressing these concerns, the WDNR has supported legislation to indemnify municipal landfills and publicly owned treatment works that accept sediment and leachate from sediment remediation projects (S. 292.70 Wisconsin State Statutes). Local landfills with sufficient capacity to receive contaminated sediment from OUs 3 and 4 exist. In fact, local

landfills may be interested in contracting for the disposal of sediments, because the sediments represent a long-term waste stream.

Securing a disposal facility is crucial to implementing this cleanup. Without a local disposal option, costs to remediate the River may increase so much that it would be necessary to reexamine remedial options. The WDNR recognizes that landfill disposal of the sediments necessitates finding sufficient property and then successfully negotiating with local waste facility disposal siting committees. It may be necessary to use existing landfills to expedite sediment disposal if the siting process is delayed. Some members of the FRG also possess landfills.

During purchase and development of the abandoned railroad right-of-way for the Fox River Trail, the WDNR negotiated with the railroad for use of the trail's right-of-way to retain the option of locating a pipeline to transport dredged sediments to potential landfill sites in the Greenleaf and Holland town area. Negotiating this right-of-way will help to avoid the time, cost, and difficulties associated with locating another pipeline route.

Master Comment 9.30

A commenter observed that natural and anthropogenic forces acting on the River and the Bay, the permanence of any solution, and the need for long-term monitoring should all be considered when evaluating remedial options.

Response

The WDNR and EPA agree with this comment and believe these items have been considered in the selection of a remedial alternative.

9.2 Cost

Master Comment 9.31

Commenters assert that the Port of Green Bay will continue to incur costs associated with the disposal of PCB-contaminated sediments as long as appreciable amounts of PCB-impacted sediments remain in the Lower Fox River and Green Bay.

Response

The need to manage navigational dredge material is a function of having an operational commercial port in Green Bay. The fact that the navigational dredge material is contaminated with PCBs is a complicating factor. Even if

the dredge material were clean, it would still need to be managed and expenses would be incurred, although more management options would be available. Brown County, as the local sponsor for the Port of Green Bay, has agreed to provide for the disposal of navigational dredge material as part of their agreement with the USACE to continue dredging the navigation channel. Over time, as navigational dredge material is removed from the River and Bay, there will be less capacity at the Bayport facility.

However, as a result of remedial activities, the amount of PCB-impacted sediments to be removed in the future should be reduced, and the costs associated with disposing of PCB-impacted sediments may therefore be considerably less after remediation is complete. In addition, less navigational dredging should be necessary for some time into the future, because material from the navigation channel is included in the remedial action. This in turn should extend the life of the Bayport facility.

Master Comment 9.32

A commenter stated that in the evaluation of cost-effectiveness, the expected reduction in PCB concentration was compared to the cost of the remedy as a means of evaluating and ranking remedial alternatives. The commenter suggested that the analysis of cost-effectiveness is based on interpolated PCB mass, which may result in overly optimistic estimates of the effectiveness of the alternatives.

Response

Concerns were raised during the comment period on the Proposed Plan about the possible use and cost of a pipeline to remove dredge slurry from the River, as well as about the size and cost of the dewatering and disposal cells recommended in the Proposed Plan. In response to these comments, the WDNR reviewed technical and cost issues associated with the Proposed Plan for OUs 3 and 4 by preparing *White Paper No. 23 – Evaluation of Cost and Implementability of Alternative C2B for Operable Unit 3 and Operable Unit 4*.

Based on the evaluations in White Paper No. 23, it can be concluded that costs are reduced by selecting the same remedial alternative for OUs 3 and 4. In addition, the basis for establishing unit costs for the cost estimates is reasonable, and the cost estimates are within the –30 to +50 percent range set forth in EPA guidance for feasibility studies.

In addition, it was determined that Alternative C2B is implementable and technically feasible. However, the dewatering and disposal facilities are land intensive and could be difficult to site because of issues associated with the

availability and acquisition of land. Siting of the disposal facility will need to follow the state siting laws, and technical issues as well as operational, monitoring, and closure plans must be addressed.

Finally, the Agencies recognize that current PCB mass and contaminated sediment volume estimates will need to be refined as part of the final project design. However, the WDNR and EPA do believe that the current estimates are adequate for initial cost estimates necessary for the FS.

Master Comment 9.33

Although some commenters stated that the total estimated cost of $310 million is reasonable, others expressed concerns that the FS and Proposed Plan do not adequately evaluate the cost of dredging and that the projected cost of the proposed dredging remedy is underestimated and misleading.

Response

The WDNR and EPA agree that the estimated costs are reasonable and will provide a protective remedy with significant benefits. The Agencies strongly disagree with the comment that the FS and Proposed Plan do not adequately evaluate the cost of dredging.

The detailed cost estimate for the Lower Fox River and Green Bay Site presented in Appendix H of the FS, which was developed based on cost estimates from previous dredging projects, adequately evaluated the cost of dredging. Landfill capacity and disposal costs in Wisconsin were included in the cost estimates. As shown in Appendix B of the FS, the dredging cost per cubic yard for the 17 projects reviewed ranged from approximately $6/cy to $507/cy. The dredging cost per cubic yard generally decreased as the volume of sediment removed increased (regardless of removal method). The dredging unit costs developed in the FS are within the range of the unit costs represented by these 17 projects. In addition, projects such as Oakland Harbor were implemented at unit costs comparable to costs in the FS for the Lower Fox River and Green Bay Site. Cost development is also discussed in Section 9.2 of the RS for OUs 1 and 2.

To assure that cost estimates were adequate and not misleading, the WDNR prepared *White Paper No. 23 – Evaluation of Cost and Implementability of Alternative C2B for Operable Unit 3 and Operable Unit 4*. Based on the evaluations in White Paper No. 23, it can be concluded that costs are reduced by selecting the same remedial alternative for OUs 3 and 4. The basis for establishing unit costs for the cost estimates is reasonable and the cost estimates are within the –30 to +50 percent range set forth in EPA guidance for feasibility studies.

9.3 Long-Term Monitoring

Master Comment 9.34

Commenters stated that the costs for long-term monitoring as outlined in the draft Model Long-Term Monitoring Plan (LTMP) (draft FS, Appendix C, October 2001) are excessive and unnecessary.

Response

The draft Model LTMP was prepared to ensure that the selected remedy adequately mitigates risk and achieves project RAOs. The purpose of the draft Model LTMP is to verify reduced risk to human and ecological receptors following remedial activities. The draft Model LTMP is based on a thorough and careful review of existing state, regional, and national monitoring programs. The WDNR and EPA also believe that the draft Model LTMP complies with requirements of the National Contingency Plan (NCP) under which Superfund efforts are conducted, because the draft Model LTMP was developed during the FS to confirm the effectiveness of the selected remedy at reducing risks to receptors from PCBs.

The WDNR and EPA believe that cost estimates for conducting the remediation and monitoring activities fall within the –30 to +50 percent range set forth in EPA guidance for this stage of the Superfund process. The WDNR and EPA also believe that a local solution is key to keeping costs from increasing. It is also quite likely that this money will have a direct, positive effect on the local economy.

A final LTMP, a Sampling and Analysis Plan, and a Quality Assurance Project Plan have been drafted and are undergoing evaluation by the WDNR, EPA, and others. These documents, which are based on the draft Model LTMP, will allow for refinement of costs. When those costs are known, they will be made public.

Master Comment 9.35

Commenters stated that the draft Model LTMP as described in the FS hinges on an unduly optimistic assumption of the time required for active remediation and that it fails to recognize that natural attenuation is occurring in areas the FS and the Proposed Plan designated for active remediation.

Response

The Agencies believe that Monitored Natural Recovery is an acceptable remedial alternative for Green Bay as well as to supplement the active

remediation in OUs 3 and 4. The draft Model LTMP was prepared to ensure that the selected remedy adequately mitigates risk and achieves project RAOs. The purpose of the draft Model LTMP is to verify reduced risk to human and ecological receptors following remedial activities. See the response to Master Comment 9.34 for a discussion of how the draft Model LTMP complies with the NCP and Superfund guidance.

The draft Model LTMP addresses the Monitored Natural Recovery alternative, including a 40-year monitoring program for measuring PCB levels in water, sediment, fish, and birds to effectively determine progress toward achieving the RAOs. MNR relies on natural processes such as degradation, burial, dispersion, and dilution to reduce contaminant concentrations to the point where they are no longer of concern.

A final LTMP, a Sampling and Analysis Plan, and a Quality Assurance Project Plan are being prepared by the WDNR in cooperation with EPA and the Natural Resource Damage trustees. These documents, which are modeled after the draft Model LTMP, take into consideration direct input from resource agencies in the states of Wisconsin and Michigan, the EPA, the USFWS, the National Oceanic and Atmospheric Administration (NOAA), and the independent Menominee and Oneida nations. The LTMP will also undergo a 5-year review process by the EPA and can be modified and extended as necessary based upon that review and the monitoring data collected.

Master Comment 9.36

Commenters stated that the proposed LTMP for Green Bay is overly broad and inconsistent with the NCP and that RAO exit criteria have already been met. The commenters stated that PCB levels are currently below baseline (pre-remedial) conditions and noted that human and ecological health are no longer at risk.

Response

The Agencies disagree with this comment. RAOs have not been met, as evidenced by the BLRA, and conditions must be monitored to determine whether RAOs are met in the future. The draft Model LTMP was prepared to ensure that the selected remedy adequately mitigates risk and achieves the Site-specific project RAOs. The draft Model LTMP was designed to document reductions in exposure to PCBs and is being used as a model for a final LTMP that will be used to verify reduced risk to human and ecological receptors following remediation. The draft Model LTMP incorporates monitoring activities relevant to demonstrating progress toward achieving the RAOs, regardless of the remedy implemented.

In developing the draft Model LTMP, the WDNR and EPA followed the appropriate guidance in assessing risk, and the Agencies stand by the risks as identified in the BLRA. Relevant discussion on the topic of risk determination can be found in the response to Master Comment 3.3 in the RS for OUs 1 and 2 RS and in *White Paper No. 12 – Hudson River Record of Decision PCB Carcinogenicity White Paper* and *White Paper No. 13 – Hudson River Record of Decision PCB Non-Cancer Health Effects White Paper*, which are attached to the RS for OUs 1 and 2.

The draft Model LTMP was drafted based on a thorough and careful review of existing state, regional, and national monitoring programs. The WDNR and EPA believe that the draft Model LTMP is consistent with the NCP and will lead to the development of a final LTMP that is also compliant with the NCP. When completed (during the remedial design stage), the final LTMP will be implemented for all Operable Units and will be modified as necessary to be consistent with the remedy for each OU.

10 Postcards, Form Letters, and Emails Sponsored by Groups

During the public comment period on the Proposed Plan for the Lower Fox River and Green Bay Site, the WDNR received many comments in the form of postcards, form letters, and emails. These items appeared to have been sponsored by different groups, two of which are the FRG and the Sierra Club. The comments submitted on postcards for these two groups reflect the range of concerns expressed in all postcards, form letters, and emails submitted. The WDNR and EPA have prepared individual responses to each of the postcard comments submitted by parties on behalf of these two organizations. For all these general concerns, more detailed responses to comments can be found throughout this RS for OUs 3, 4, and 5 and in the earlier published RS for OUs 1 and 2. The Agencies encourage those who submitted postcards, form letters, and emails to review the complete RS and not just this section.

Master Comment 10.1

Approximately 2,200 postcards were received as a result of a mailing effort sponsored by the FRG. In addition, approximately 160 form letters having the same content were submitted. The content of these submittals reads as follows:

"DNR – Proposed Plan Has Too Much Dredging! I want a restoration plan that:

- *Protects the environmental and economic health of Northeast Wisconsin.*
- *Relies on a sensible mixture of natural recovery, capping and dredging based on sound scientific data from the Fox River.*
- *Contains requirements for the monitoring of results and the performance of scientific evaluations as projects proceed to make sure that the cleanup measures are safe and effective.*
- *Contains valid realistic cost estimates and work schedules so an appropriate and informed decision can be made about the right mix of natural recovery, capping and dredging for the Fox River."*

Response

Individual responses to each of these points follow.

FRG Bullet No. 1 – Protects the environmental and economic health of Northeast Wisconsin.

Wisconsin statutes and the NCP both require that the selected remedy be protective of human health and the environment and the selected remedy fulfills this requirement.

The WDNR and EPA followed appropriate guidance in assessing risk and believe that the BLRA adequately differentiates the risks involved for each reach/zone of the exposure area. The WDNR and EPA have determined that the exposure and intake assumptions used in the BLRA are appropriately conservative, relevant to the Site, and consistent with standard and customary EPA approaches. The exposure estimates used in the BLRA were carefully selected based on the literature as well as on communication with various Agency personnel. The ecological risk assessment in the BLRA, specifically, was prepared with the assistance of the Site-specific Biological Technical Assistance Group (BTAG) and EPA's national expert on ecological risk assessment. One of the responsibilities of the BTAG and the national expert was to ensure that the BLRA followed EPA guidance. Whenever inconsistencies were noted, they were corrected so that the final document was in fact in accordance with EPA guidance.

In addition, the Agencies believe that other sediment remediation projects have resulted in economic improvements after completion of sediment cleanup. Although preparation of a specific economic analysis and educational material is beyond the scope of the RI/FS and ROD, the WDNR and EPA are mindful of the economic consequences on the local economy of a large-scale, multi-year cleanup project in the Fox River Valley. Both Agencies have publicly stated that the selected remedy for the Lower Fox River should not be unnecessarily harmful to the local economy, and it is the Agencies' belief that the remedy selected in the ROD will fulfill this concept.

A project of the magnitude called for in the ROD will bring many jobs and paychecks to the Fox River Valley. While the Agencies have not specifically quantified the economic benefits, certainly many local suppliers of material needed for the remediation will see an increase in orders. To be sure, the remedy called for in the ROD is expensive, but these are dollars that will be spent in the Fox River Valley—on equipment, fuel, supplies, hotels, restaurants, etc.—all of which will have beneficial economic impacts on the valley. At the conclusion of the cleanup work, a clear but intangible benefit will be a cleaner River for all citizens of the valley to enjoy. Increased tourism should result as the Fox River Valley becomes a more attractive destination and the world-class fishery of the River is rehabilitated. The Agencies have reviewed the financial health of the several companies likely to be most impacted financially by the ROD and have concluded that they can undertake the financing for a project of this magnitude without unnecessary

harm (see *White Paper No. 17 – Financial Assessment of the Fox River Group*).

FRG Bullet No. 2 – Relies on a sensible mixture of natural recovery, capping and dredging based on sound scientific data from the Fox River.

The WDNR and EPA agree with this comment and believe these items have been considered in the selection of a remedial alternative. As part of the Agencies' evaluation of comments on the RI/FS and Proposed Plan, the costs associated with the 1 ppm cleanup level were reviewed again. For the present phase of the project, the WDNR and EPA believe that cost estimates fall within the acceptable range per federal Superfund guidance. The WDNR and EPA do consider the cost-effectiveness of a remedy when choosing that remedy. That is, the WDNR and EPA chose the remedy that will provide the needed level of protection for the least amount of money.

The remedy for this Site is large and therefore expensive. As with any large construction project, the cost estimates will have uncertainty. However, the WDNR and EPA believe that the remedy will significantly reduce risks in the Lower Fox River, as discussed in the sections of this RS dealing with risk and selection of the RAL.

Selection of a site remedy is based on protection of human health and the environment. The FS (Sections 6 and 7) looked at and evaluated numerous technologies and combinations of technologies for remedial purposes, as also discussed in the Proposed Plan. For instance, the alternative in the Proposed Plan is a combination of dredging and MNR for the residual sediment in the OU where dredging is selected. The ROD in fact reflects a mixture of remedies, including removal and natural recovery along with provisions for capping or thermal treatment alternatives where appropriate.

FRG Bullet No. 3 – Contains requirements for the monitoring of results and the performance of scientific evaluations as projects proceed to make sure that the cleanup measures are safe and effective.

The design of the remedy selected for each OU of the River will include performance measures and monitoring to assure that the remedy achieves and maintains the cleanup goal. The Agencies are currently developing a final LTMP, a Sampling and Analysis Plan, and a Quality Assurance Project Plan, which are based on the draft Model LTMP, that will address the commenters' specific issues and contain the level of clarity and detail requested by the commenters. These documents will be based on a thorough and careful review of existing state, regional, and national monitoring programs. The

WDNR and EPA believe that the draft Model LTMP is consistent with the NCP, in that it was developed as part of the FS to confirm the effectiveness of the selected remedy at reduce risks to receptors from PCBs as well as other chemicals of concern. In addition, the draft Model LTMP took into consideration direct input from resource agencies in the states of Wisconsin and Michigan, as well as the EPA, USFWS, NOAA, and the independent Menominee and Oneida nations. These resource agencies determined that, given the magnitude of PCB contamination in Green Bay, MNR could not be selected as the remedial alternative without a comprehensive, Bay-wide program that monitors all important species, not just fish. The LTMP is to be implemented for all OUs and will be modified in the remedial design stage to be consistent with the remedy selected for each individual OU. For further discussion, refer to the response to Master Comment 8.3 in the RS for OUs 1 and 2.

FRG Bullet No. 4 – Contains valid realistic cost estimates and work schedules so an appropriate and informed decision can be made about the right mix of natural recovery, capping and dredging for the Fox River.

The WDNR and EPA agree with this comment and believe these items have indeed been considered in the selection of a remedial alternative. The Agencies believe the estimated costs are reasonable and will provide a protective remedy with significant benefits. In preparing the RI/FS, the Proposed Plan, and the ROD, the WDNR, with assistance from the EPA, followed all the appropriate guidance for completing these documents. The level of detail afforded in these documents is consistent with what Superfund guidance calls for at this stage in the process, including cost estimates within the –30 to +50 percent range. For instance, the detailed cost estimate for the Lower Fox River and Green Bay Site presented in Appendix H of the FS was developed based on cost estimates from previous dredging projects. Landfill capacity and disposal costs in Wisconsin were determined and included in the cost estimates, and Appendix B of the FS details the total dredging cost per cubic yard for 17 projects reviewed. It is apparent that the dredging unit costs developed in the FS are within the range of the unit costs represented by the 17 projects. In addition, the costs associated with the 1 ppm cleanup level were reviewed again as part of the Agencies' evaluation of comments on the RI/FS and Proposed Plan.

It is important to recognize that at this point, the WDNR and EPA are selecting an option, not formally adopting a fully designed engineering remediation plan. With the completion of the ROD, the WDNR and EPA will begin the detailed engineering design, which will refine the FS cost estimates. For further discussion, refer to the response to Master Comment 9.8 in the RS for OUs 1 and 2.

Master Comment 10.2

Approximately 900 postcards were received as a result of a mailing effort sponsored by the Sierra Club. In addition, approximately 80 form letters and approximately 1,000 emails with similar content were submitted. It is unclear who sponsored the later form letters and emails. The content of the postcard from the Sierra Club reads as follows:

"Thank you for the opportunity to comment on the Fox River cleanup plan. I applaud the decision to remove the majority of the PCBs from the river where they threaten public health and the environment, though I urge you to make the following changes:

- *Change the action level to 0.25 ppm. The FS indicates that 0.25 ppm will meet as many human health and wildlife objectives as possible, while the current 1 ppm level is not protective enough. A 0.25 ppm action level meets 7 of 8 human health goals for average exposures while 1 ppm only meets 1 of the 8 goals. For wildlife, 1 ppm meets only 4 of 9 goals; 0.25 ppm will meet 7 of the 9. Finally, the FS notes that for all reaches, 0.25 ppm is "the most cost effective action level that meets protective thresholds."*

- *Dredge the mouth of Green Bay (Zone 2). The RI indicates that Zone 2 contains almost half of all the PCBs in Green Bay – more than are in the entire Fox River. According to the FS, it will cost less per pound of PCBs to clean up this zone of the Bay than it will cost to clean up the river. We cannot ignore such a large, readily accessible mass of PCBs and still consider this a complete cleanup, particularly when Green Bay is a major source of PCBs both to the air and to Lake Michigan.*

- *Complete a more thorough assessment of Green Bay. Previous research indicates that there may be hotspots that are not adequately characterized, especially along the eastern shore of the Bay.*

- *Dredge deposit DD in the Appleton to Little Rapids reach when remediating the adjacent Operational Unit 3. It makes sense to use every opportunity to remove PCBs from the ecosystem."*

Response

Individual responses to each of these points follow.

Sierra Club Bullet No. 1 – Change the action level to 0.25 ppm. The FS indicates that 0.25 ppm will meet as many human health

and wildlife objectives as possible, while the current 1 ppm level is not protective enough. A 0.25 ppm action level meets 7 of 8 human health goals for average exposures while 1 ppm only meets 1 of the 8 goals. For wildlife, 1 ppm meets only 4 of 9 goals; 0.25 ppm will meet 7 of the 9. Finally, the FS notes that for all reaches, 0.25 ppm is "the most cost effective action level that meets protective thresholds."

The basis for selection of the RAL was identified in the Proposed Plan and is further explained in the ROD. The WDNR and EPA selected the 1 ppm RAL based on an evaluation of multiple action levels with the residual SWAC for each OU and the ability of the action level to meet the RAOs. The Agencies in particular considered the time to achieve removal of fish consumption advisories, as well as the reduction in impacts to the ecosystem. The WDNR and EPA carefully considered more and less stringent cleanup levels (RALs) before arriving at the 1 ppm level in the ROD. Multiple RALs considered for each OU include no action and 0.125, 0.25, 0.5, 1, and 5 ppm. Model forecasts were used to compare the projected outcomes of the remedial alternatives under various action levels with the RAOs, primarily with RAOs 2 and 3, which deal with protection of human health and the environment. On the basis of that analysis and to achieve the risk reduction objectives using a consistent action level, 1 ppm was selected by the Agencies as the appropriate RAL.

The 1999 draft RI/FS called for an action level of 0.25 ppm or a 0.25 ppm SWAC, with neither being selected. The WDNR and EPA do not believe the 1 ppm RAL is inconsistent with what was called for in the 1999 draft RI/FS. As presented in Table 1 of *White Paper No. 11 – Comparison of SQTs, RALs, RAOs, and SWACs for the Lower Fox River*, the SWAC in OU 3 and OU 4 at the 1 ppm RAL results in a SWAC equal to or lower than the 0.25 ppm SWAC presented in the 1999 draft RI/FS.

This cleanup standard is not arbitrary, and the Agencies gave careful consideration to what is needed to be protective and meet the RAOs. The selection of the cleanup level is the outcome of a complete and scientifically based risk evaluation. In selecting the 1 ppm RAL, the WDNR and EPA considered RAOs, model forecasts of the time necessary to achieve risk reduction, the post-remediation SWAC, comparison of the residual concentration to SQTs for human and ecological receptors, sediment volume and PCB mass to be managed, and cost. The 1 ppm RAL is the best mechanism for achieving these goals. This is consistent with the process identified in the Proposed Plan.

Sierra Club Bullet No. 2 – Dredge the mouth of Green Bay (Zone 2). The RI indicates that Zone 2 contains almost half of all the

PCBs in Green Bay – more than are in the entire Fox River. According to the FS, it will cost less per pound of PCBs to clean up this zone of the Bay than it will cost to clean up the river. We cannot ignore such a large, readily accessible mass of PCBs and still consider this a complete cleanup, particularly when Green Bay is a major source of PCBs both to the air and to Lake Michigan.

The GBMBS data estimated that during the 1989 to 1990 period up to 24 kg/yr (53 pounds/year) of PCBs volatilized from the River and up to 150 kg/yr (331 pounds/year) of PCBs volatilized from Green Bay. The Agencies believe that addressing the continuing PCB discharge from the Lower Fox River to Green Bay will lead to the reduction of long-term risks in Green Bay.

There are significant technical and practical concerns associated with implementing any remedial action alternative in Green Bay, as well as significant costs associated with dredging in the Bay. As presented in Section 8 of the FS, it would be necessary to remediate the entirety of a Green Bay zone for any measurable risk reduction to be obtained. The proposed remediation of the Lower Fox River is expected to reduce future PCB loadings by 98 percent. Through this PCB load reduction, the Lower Fox River and Green Bay will have the opportunity to stabilize, and volatilization and atmospheric transport will be less of an issue. The WDNR and EPA also believe the selected remedy goes a long way toward protecting Lake Michigan, in that the remedy in the ROD will reduce the single largest source of PCBs being discharged into Lake Michigan, the Lower Fox River. This effort, along with the combined effects of successful remediation at other remedial sites along the shoreline and tributaries to Lake Michigan, will contribute to the lake's overall protection.

The Agencies believe that addressing the continuing PCB discharge to Green Bay is more cost-effective at reducing the long-term risks in Green Bay than would be active remediation in any portion of the Bay. As demonstrated in Table 11-17 of the ROD, remediating the 29,322,250 cy volume in Zone 2 of Green Bay, would cost an estimated $698 million to $814 million. According to information gathered for the FS, CAD construction is estimated for Zone 2 at $358,700,000 and $54,600,000 for action levels of 500 and 5,000 ppb, respectively, and only $15,500,000 for disposal at the Renard Island CDF (including closure). Although Renard Island is the more cost-effective disposal alternative indicated in the FS for Zone 2 of Green Bay, the WDNR and EPA have not pursued the siting of an in-water disposal facility due to the impracticalities, such as the lack of existing disposal capacity, environmental concerns, and the difficulty of obtaining public approval and support. In a recent court case involving an attempted expansion of Renard Island by Brown County and the USACE, it was decided that water quality and oxygen levels could become threatened. The level of public comment received in

opposition to expansion of Renard Island, as well as numerous comments opposing the use of confined disposal facilities (see the RS for OUs 1 and 2), indicates that use of an in-water disposal facility is not implementable.

Furthermore, the Agencies are undertaking a reevaluation of the extent of the contaminated area adjacent to the River mouth. The Agencies will more clearly define the extent of contamination from the River's mouth into Green Bay during the first stage of the remedial design phase as part of the Pre-design Sediment Characterization, which will delineate the area that will be included in the remedy for OU 4. As part of the remediation effort for OU 4, all contaminated sediment with a PCB concentration of greater than 1 ppm extending into the River mouth will also be subject to removal. Currently, the Agencies do not have a sufficient delineation of the sediment volume or PCB mass in this area, although the Agencies do not expect the volume of material to exceed a few thousand cubic yards.

Sierra Club Bullet No. 3 – Complete a more thorough assessment of Green Bay. Previous research indicates that there may be hotspots that are not adequately characterized, especially along the eastern shore of the Bay.

To address concerns raised about Green Bay, the WDNR undertook several actions, which included reevaluating the PCB mass and contaminated sediment volume in the Bay (documented in *White Paper No. 18 – Evaluation of an Alternative Approach of Calculating Mass, Sediment Volume, and Surface Concentrations in Operable Unit 5, Green Bay*); conducting additional sampling in the south end of the Bay (documented in *White Paper No. 19 – Estimates of PCB Mass, Sediment Volume, and Surface Sediment Concentrations in Operable Unit 5, Green Bay Using an Alternative Approach,* which also provides estimates of PCB mass and contaminated sediment volume incorporating the new data); and conducting additional modeling to evaluate removal of contaminated sediments (documented in *White Paper No. 20 – Green Bay Modeling Evaluation of the Effects of Sediment PCB Bed Map Revisions on GBTOXe Model Results* and *White Paper No. 21 – Green Bay Modeling Evaluation of a Hypothetical Open-Water Disposal Site for Navigational Dredged Material in Southern Green Bay*). All four white papers are appended to this RS.

Collectively, the results of these white papers reveal that PCB mass and volume estimates may change dramatically depending upon assumptions made in estimating these values, but also show that surface concentrations do not change significantly. The results of the July 2002 sampling in the southern Bay showed that there were no areas with high elevations of PCBs. The results of the additional modeling reveal that changes to mass in Zone 2 of OU 5 do affect the initial conditions for the GBTOXe model results but

result in Zone 2 PCB projections that are more consistent with zones 3A, 3B, and 4 of OU 5 (White Paper No. 20). The second model white paper (White Paper No. 21) evaluated how sediments dredged from the federally maintained navigation channel and disposed of in the open-water disposal areas that were operated up until the 1970s might have affected PCB distribution in the Bay. That work illustrated how PCBs within a hypothetical dredge material disposal site would be initially high in Zone 2 but would tend to become less appreciable within a 10-year time frame. Furthermore, there is no appreciable impact to sediment and water column PCB concentrations for zones 3A, 3B, and 4. In addition to the modeling work, additional samples collected within those areas did not show any detectable PCBs. Collectively, these results demonstrate that concerns about elevated PCBs from dredged material disposal are unfounded.

The Agencies have also initiated a Pre-design Sediment Characterization project that will provide a more accurate delineation of the extent of sediment contamination throughout OUs 1, 3, and 4. This pre-design characterization is the last step necessary before the actual remedy design can begin. In OU 4, the characterization will extend beyond the River mouth into Zone 2 of Green Bay. This data collection activity will provide the final delineation of the PCB-contaminated sediment that will be addressed during implementation of the OU 4 remediation.

Sierra Club Bullet No. 4 – Dredge deposit DD in the Appleton to Little Rapids reach when remediating the adjacent Operational Unit 3. It makes sense to use every opportunity to remove PCBs from the ecosystem.

The WDNR and EPA have evaluated and addressed sediment Deposit DD, which is located in OU 2, the reach from Appleton to Little Rapids. The ROD for OUs 3, 4, and 5 provides for the removal by dredging of 586,800 cy of contaminated sediments containing 1,111 kg (2,444 pounds) of PCBs from OU 3. In addition, the ROD calls for the removal of Deposit DD from OU 2 as part of the OU 3 remedy. Deposit DD adds approximately 9,000 cy of contaminated sediment and 31 kg (68 pounds) of PCB mass above the 1 ppm RAL to the OU 3 project. Therefore, totals for OU 3 and Deposit DD are 1,142 kg (2,512 pounds) of PCBs and 595,800 cy of contaminated sediment.